HYPONATREMIA AS A PREDICTOR OF SEVERITY IN PAEDIATRIC COMMUNITY ACQUIRED PNEUMONIA

Dissertation submitted to

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

CHENNAI

In partial fulfilment of the regulations for the award of degree of

M.D. PAEDIATRICS

(BRANCH VII)

INSTITUTE OF CHILD HEALTH AND

HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

CHENNAI

APRIL – 2016

CERTIFICATE

This is to certify that the dissertation titled "**HYPONATREMIA AS A PREDICTOR OF SEVERITY IN PAEDIATRIC COMMUNITY ACQUIRED PNEUMONIA"** submitted by **Dr.N.THRILOK** to the Faculty of Paediatrics, **THE TAMILNADU DR.MGR MEDICAL UNIVERSITY, CHENNAI,** in partial fulfilment of the requirements for the award of M.D. Degree (Paediatrics) is a bonafide research work carried out by him under our direct supervision and guidance.

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DECLARATION

I **Dr.N.THRILOK,** solemnly declare that the dissertation titled "**HYPONATREMIA AS A PREDICTOR OF SEVERITY IN PAEDIATRIC COMMUNITY ACQUIRED PNEUMONIA"** has been prepared by me.

This is submitted to The TamilNadu **Dr.M.G.R.Medical University** Chennai in partial fulfilment of rules and regulations for the M.D.Degree Examinations in Paediatrics.

DR.N.THRILOK

Place : Chennai

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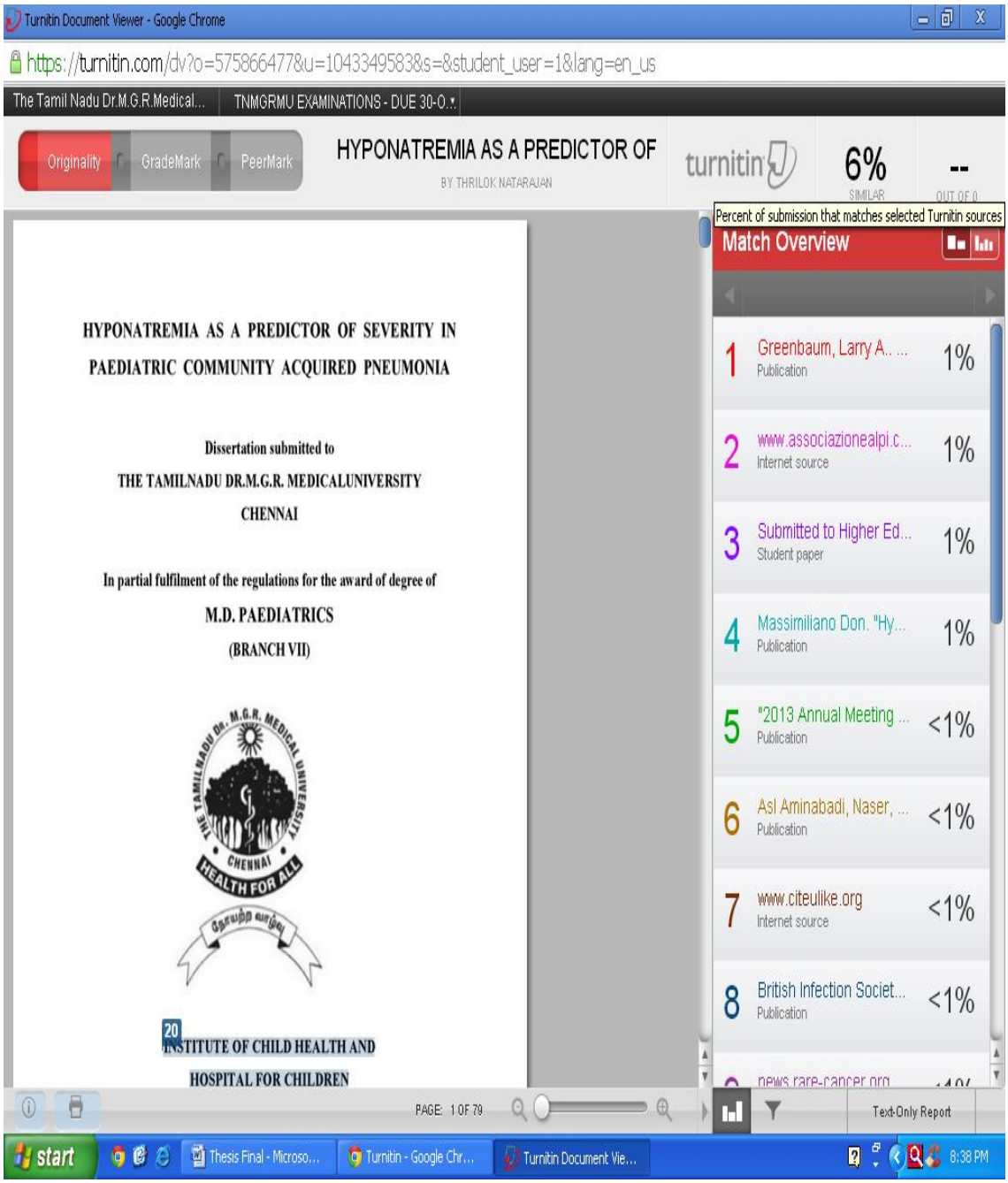
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ABBREVATIONS

ADH	-	Anti Diuretic Hormone
ALRTI	-	Acute Lower Respiratory Tract Infection
ATN	-	Acute Tubular Necrosis
ATP	-	Adenosine Tri Phosphate
AMP	-	Adenosine Mono Phosphate
AQP	-	Aquaporin
AVP	-	Arginine Vasopressin
BTS	-	British Thoracic Society
CAP	-	Community Acquired Pneumonia
CCF	-	Congestive Cardiac Failure
CNS	-	Central Nervous System
CRP	-	C Reactive Protein
DM	-	Diabetes Mellitus
DNA	-	Deoxyribo Nucleic Acid
ECF	-	Extra Cellular Fluid
ESR	-	Erythocyte Sedimentation Rate
GABHS	-	Group A Beta Hemolytic Streptococci
GAPPD	-	Global Action Plan for Pneumonia and Diarrhoea
GIT	-	Gastro Intestinal Tract
HIV	-	Human Immunodeficiency Virus
IPD	-	Invasive Pneumococcal Disease
LRI	-	Lower Respiratory Infection
PED	-	Pediatric Emergency Department
RNA	-	Ribo Nucleic Acid
RSV	-	Respiratory Syncytial Virus

RTA	-	Renal Tubular Acidosis
SAM	-	Severe Acute Malnutrition
SIADH	-	Syndrome of Inappropriate Anti Diuretic Hormone
SPSS	-	Statistical Package for Social Sciences
TBW	-	Total Body Water
UNICEF	-	The United Nations Children’s Fund
URI	-	Upper Respiratory Infection
WBC	-	White Blood Cell

CONTENTS

HYPONATREMIA AS A PREDICTOR OF SEVERITY IN PAEDIATRIC COMMUNITY ACQUIRED PNEUMONIA

ABSTRACT

BACKGROUND

Hyponatremia is a common electrolyte disturbance occurring in hospitalised children. The objective of the study isto find out the incidence of hyponatremia in children aged 2months to 5 years hospitalised with community acquired pneumonia and to find out whether it could be used as a predictive tool to assess the severity of pneumonia.

MATERIALSAND METHODS

This was a prospective study conducted in 120 children admitted with symptoms of pneumonia who satisfied the inclusion criteria. All the clinical findings were documented at the time admission. Serum sodium levels were sent along with other investigations and the frequency in children was found. The association of hyponatremia with other clinical and laboratory parameters was studied to assess its role in predicting the severity of the disease.

RESULTS

Hyponatremia was found in 40.8% of children at the time of admission. Mild hyponatremia was seen in 24.2% and moderate hyponatremia was seen in16.7%.This study showed that hyponatremia was seen commonly in infants (p= 0.001).

Hyponatremia was associated with initial high temperature ($p < 0.001$), tachycardia ($p < 0.001$), leucocytosis($p<0.001$) , increased neutrophil count ($p < 0.001$)and reactive thrombocytosis ($p < 0.001$) .The study showed that hyponatremia was associated more commonly with lung consolidation followed by bronchopneumonia ($p < 0.001$). Hyponatremia was associated with prolonged length of hospital stay ($p < 0.001$) and requirement of mechanical ventilation ($p < 0.001$) .4 children expired and all of them were found to be hyponatremic($p =0.004$). Estimated serum osmolality, urine spot sodium and urine osmolality values show that most of the cases of hyponatremia are of euvolemic type probably occurring as a result of stress induced ADH release.

CONCLUSION

This study shows that hyponatremia is a common electrolye disturbance occurring in children hospitalised with pneumonia. As most of the cases are euvolemic hyponatremia fluid restriction is necessary.Hyponatremia can be used to predict the severity of disease and morbidity of the disease to a certain extent.

KEYWORDS:

Hyponatremia, Paediatric community acquired pneumonia.

INTRODUCTION

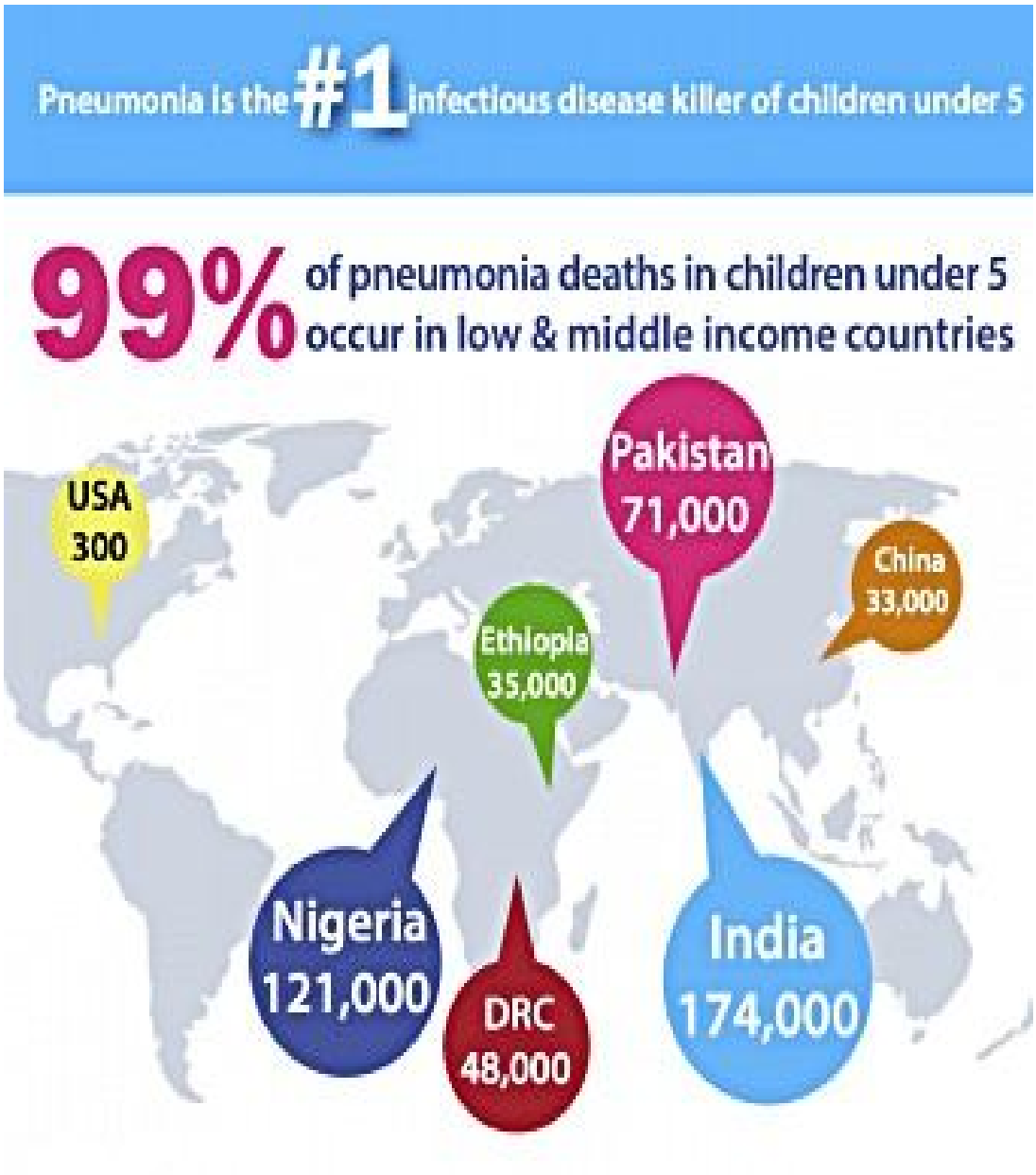
Acute respiratory tract infections are one of the most common infections occurring in children. Pneumonia, the severe form of ALRTI is one of the most important cause of morbidity and mortality in children especially from the developing nations. Pneumonia is the infection and associated inflammation of the lung parenchyma[1].

The word pneumonia has its origin from the Greek word 'Pneumon'- the organ which moves air in and out of the body. The inflammation involving the pneumos is pneumonia. Pneumonia can occur due to both infectious and non-infectious causes. Pneumonia can present in many ways and can also lead to many complications. Hyponatremia is a common electrolyte disturbance occurring in children hospitalised with pneumonia.But hyponatremia is a frequently overlooked complication and not much importance is paid to it. Most of the cases of hyponatremia occur as a response to stress which causes increased ADH release which in turn causes water retention[2].

BURDEN OF DISEASE

Pneumonia is the leading infectious killer of under 5 children claiming more lives than any other diseases. The burden is more in the developing nations. Around 15% of under 5 mortality is attributed to pneumonia. Pneumonia caused death of around 9,35,000 (estimated value) children from around the world in the year 2013[3]. India and Nigeria are

the two countries which contributed to majority of cases[4]. The regions with high prevalence of the disease are South Asia and sub Saharan Africa.



PULMONARY DEFENCE MECHANISM

The respiratory tract and its mucosal surfaces provide the host with multiplicity of defence mechanisms. The pulmonary system consists of mechanical, non-immunological and immunological defence mechanisms.

- Mechanical- anatomy of respiratory tract
- Non-immunological - mucociliary clearance mechanism and protective reflexes(cough, sneezing)
- Immunological- secretory Ig A and cells of the immune system[1,5]

A breach in any of these defence mechanisms will often lead to infection. Apart from these there are many factors which increase the vulnerability to infection like

- Protein energy malnutrition
- Poor socioeconomic status
- Lack of breast feeding
- Zinc deficiency
- Exposure to tobacco smoke
- Overcrowding
- Indoor air pollution
- HIV[6]

CLASSIFICATION OF PNEUMONIA[1,5,7]

There are a number of classification systems available for pneumonia. They can be classified based on aetiology, anatomy, source of infection etc.

BASED ON SOURCE

1. **COMMUNITY ACQUIRED PNEUMONIA**

   It is the infection acquired from the organisms present in the community in children who have not been hospitalised in recent past .

2. **NOSOCOMIAL PNEUMONIA**

   Here the infection occurs after 48 to 72 hours of hospital admission.

BASED ON PATHOLOGY

1. **LOBAR PNEUMONIA**

   There is homogenous involvement of the entire lobe of the lung. It is mostly caused by bacteria. It is pathologically characterised by 4 stages

   - Congestion,
   - Red hepatisation,
   - Grey hepatisation and
   - Resolution.

2. **BRONCHOPNEUMONIA**

   Bronchopneumonia is characterised by patchy consolidation involving one or several lobes of the lung. Dependent parts of the

lung are commonly involved. It can be caused by bacteria, virus and atypical organisms.

3. INTERSTITIAL PNEUMONIA:

Inflammation involves the interstitial tissues of the lung.

4. MILIARY PNEUMONIA

This type of pneumonia spreads to lungs through hematogenous route producing multiple discrete lesions. Usually caused by tuberculosis ,histoplasmosis, coccidomycosis etc.

ETIOLOGY

The etiological agent causing infection varies with different age groups. In neonates Group B Streptococci and E.coli are responsible for majority of causes of pneumonia.Between 3 weeks to 4 years viruses are the most common cause of infection. Atypical organisms predominate the list beyond 5 years of age[1,8-10].

The aetiological agents which cause infection in different age groups and the most common organism causing infection in each age group is given below

AGE	MOST COMMON	OTHERS
0 to 3 weeks	Group B Streptococci E.coli Klebsiella Listeria	Streptococci Pneumococci Hemophilus influenza
3wks to 3 mon	RSV Other viruses (influenza, Parainfluenza, adenovirus)	Pneumococci Staphylococcus aureus Hemophilus influenza Chlamydia trachomatis
4 mon to 4 years	RSV Other viruses	Pneumococci Hemophilus influenza Group A streptococci Mycoplasma pneumoniae
Over 5 years	Mycoplasma pneumoniae	Chlamydophila pneumoniae Pneumococci Legionella Viruses Hemophilus influenza

PNEUMOCOCCAL PNEUMONIA

Pneumococci are gram positive lanceolate diplococci. It is typically small slightly elongated cocci with one end broad and the other end rounded. They occur in pairs with broad ends in apposition. The capsule usually encloses each pair of cocci. The polysaccharide capsule of the bacteria is an important virulence factor which prevents phagocytosis by the neutrophils.

It is the most common bacterial cause of pneumonia in children. Primary infection with pneumococci is as such rare. Usually follows a viral URI. The disease onset is marked by sudden onset of fever, breathlessness, chills etc. The child appears toxic and ill. Often leads to

consolidation of lobes. Invasive pneumococcal disease (IPD) is rare in immunocompetent children. There is increased risk of IPD in the following conditions

- Age < 36 months
- Sickle cell anaemia
- Asplenia
- HIV
- Cochlear implant
- Chronic diseases (DM, immunodeficiency, asthma etc.)[11]

STREPTOCOCCAL PNEUMONIA

Streptococci are gram positive cocci arranged in chains. GABHS infection usually occurs after any exanthematous fever. It is an aggressive disease. It produces interstitial type of lung involvement. Pneumatocele, lung abscess or empyema can occur as complications with this infection.Pericarditis and peritonitis are less frequent complications. Focal bronchiectasis and fibrosis can occur as a sequelae of infection.

STAPHYLOCOCCAL PNEUMONIA

Infection with staphylococci is less common in immunocompetent children. The disease has a fulminant course and hence should be treated vigorously. The bacteria multiplies rapidly producing a necrotising toxin

which is implicated in tissue destruction. Pneumatocele, pneumothorax and empyema can occur as complications.[12-14]

MYCOPLASMA PNEUMONIA

It is the most common cause of ALRTI in children above 5 years of age. Also known as 'Walking Pneumonia'. The infection usually produces a low grade fever. Dry cough and dyspnoea is usually preceded by prodromal symptoms like headache, malaise, URI etc. The infection can also occur in younger children. Chest X- ray predominantly shows an interstitial infiltrate. About half of the patients may show a positive cold agglutinin test which is non-specific. It causes complications like pleural effusion, ARDS etc. Myocarditis, encephalopathy, maculopapular rash and erythema nodosum can occur as extra-pulmonary complications.[15-18]

KLEBSIELLA

Klebsiella is a gram negative nonmotile capsulated rod shaped bacilli. Most common in immunocompromised children. Mostly causes nosocomial infections but can also cause community acquired pneumonia. The infection with this organism begins as sudden onset of fever with chills. The cough is usually productive which produces a blood tinged sputum (red currant jelly sputum). The involvement of the lung is usually unilateral with involvement of upper lobe more commonly. Complications

like lung abscess, cavitation and empyema can occur increasing the morbidity of the illness.

CHLAMYDIA TRACHOMATIS PNEUMONIA

The infection with this organism occurs in infants born to mothers with genital infection. The newborn presents with conjunctivitis, nasopharyngitis and rarely with neonatal pneumonia. This infection typically causes afebrile pneumonia. There may be cough and tachypnea. On auscultation of chest scattered crackles may be heard. The involvement of the lung can be either lobar or interstitial.

CHLAMYDIA PNEUMONIAE

It usually causes infection in older children and adolescents either bronchitis or mild pneumonia. Initially starts as an infection of the upper respiratory tract. The symptoms persist for longer period and then the child may develop headache and hoarseness of voice. The child may have both wheeze and crackles on auscultation. The infection increases the risk of mortality in children with sickle cell disease.

VIRAL PNEUMONIA

It is the most common malady affecting children throughout the world. RSV is the most common cause of pneumonia in age less than 2 years. The other viruses which cause infection are influenza, para

influenza, adenovirus etc. About a third of viral pneumonias are complicated by bacterial infection.[19-20]

Respiratory syncytial virus causes infection more commonly in children less than 2 years. It can cause both pneumonia and bronchiolitis. In RSV pneumonia the child presents with fever and breathlessness. On examination the child tend to have more of crackles than wheeze. Most of them will recover in a few days with supportive treatment.[21]

Influenza is an RNA virus which causes infection more commonly in winter. The risk of infection is increased in children with chronic illness. The symptom starts 1 to 5 days after being infected with the virus. The infection usually starts as upper respiratory tract infection. The children may present with high fever with chills and breathlessness. Secondary bacterial infection may complicate the clinical picture. The virus is popular to cause pandemics because of changing strains. Oseltamivir is used in the treatment of this infection.[22-23]

Human parainfluenza virus 1 and 3 are the agents which can cause LRI like bronchiolitis, bronchitis, pneumonia etc.

Adenovirus is an enveloped DNA virus. Mostly causes upper respiratory tract infection but can also cause lower respiratory tract infection. The infection is usually mild and self-limited.

PATHOPHYSIOLOGY

The pathogenesis of pneumonia and the response of the immune system varies between organisms.

Most of the viral pneumonia begins as infection of the upper respiratory tract. The infection then spreads to the lower respiratory tract. The organisms then multiply and spread to involve the distal parts of the respiratory tract. The ciliary function of the respiratory epithelium is lost which results in stasis of secretion. The alveoli also will lose their function and structural integrity. This results in loss of surfactant synthesis and finally leads to development of pulmonary oedema. The mononuclear cells infiltrate the sub mucosa and interstitium. This results in tissue oedema and narrowing of the airway calibre. The exchange of gas across alveolar capillary membrane is also affected. The important factors which determine the severity of viral pneumonia are anatomy of the respiratory tract, pre-existing pulmonary disease and immunity of the host.

In bacterial pneumonia the most important factor in the pathogenesis is the virulence of the organism. The process starts with colonisation of the nasopharynx. This is then followed by aspiration or bacteraemia. The normal defence mechanisms usually will prevent the development of pneumonia. When the barriers are breached or overwhelmed pneumonia will occur.

Mycoplasma is a mucosal pathogen. It attaches to the epithelium and triggers the inflammatory cascade leading to infiltrates. Attachment of the organism produces cytopathic effects on the epithelium finally resulting in loss of metabolic functions and cell death.[1,8]

CLINICAL FEATURES

Pneumonia can present in a myriad of ways and the clinical presentation may vary in different age groups. The common features are

- Fever
- Cough and cold
- Breathlessness
- Chest indrawing
- Lethargy
- Poor feeding
- Shock
- Respiratory failure[24-25]

The WHO has established an agewise cut-off for respiratory distress in children. The cut-off values are given in the table below.

AGE	RESPIRATORY RATE
Up to 2 months	Above 60/ mt
2months to 12 months	Above 50/mt
1 to 5 years	Above 40/ mt
Above 5 years	Above 20/ mt

GLOBAL ACTION PLAN FOR PNEUMONIA AND DIARRHOEA[3]

UNICEF AND WHO have developed the integrated Global Action Plan for treatment and control of Pneumonia and Diarrhoea (GAPPD) for decreasing deaths due to diarrhoea and pneumonia by 2025. The aim of this plan is to accelerate the control of pneumonia through the following actions

- Protection
- Prevention
- Treatment

Protection of children from pneumonia is achieved by promotion of exclusive breastfeeding and also providing proper supplementary feeding. Children are prevented from pneumonia by proper vaccination of children, proper hand washing, decreasing the indoor air pollution,

prevention of HIV infection in children and prophylaxis with cotrimoxazole in HIV infected children.

It has also revised the classification system for treatment of childhood pneumonia at first level health facility and out-patient department. The two new categories in the treatment of children with respiratory distress between 2 months and 5 years are

CLASSIFICATION	CLINICAL FEATURES	TREATMENT
PNEUMONIA	Fast breathing Chest in drawing	Oral Amoxicillin Home based care
SEVERE PNEUMONIA OR VERY SEVERE PNEUMONIA	General danger signs • Not able to drink • Persistent vomiting • Convulsion • Lethargy • Unconsciousness • Stridor in a calm child • SAM	First dose antibiotic and referral to a heath care facility

COMPLICATIONS

Pneumonia can cause a wide variety of complications in paediatric age group. It can cause both pulmonary and extra pulmonary complications. Direct spread of organisms within the thoracic cavity can cause complications like empyema, pleural effusion, lung abscess pyopneumothorax, pericarditis, pericardial effusion etc. Spread of infection through blood to different organs can result in complications like sepsis,

meningitis, septic arthritis, osteomyelitis etc. Pneumonia can also cause electrolyte disturbances of which hyponatremia is a more common entity.[9,26-29]

PULMONARY	EXTRAPULMONARY
Pleural effusion Pneumothorax Lung abscess Pneumatocele Empyema Pyopneumothorax Atelectasis Necrotising pneumonia	Bacteraemia and sepsis Pericarditis Pericardial effusion Meningitis Septic arthritis Osteomyelitis Electrolyte imbalances

HYPONATREMIA[1,30-31]

Sodium is a predominant cation of extracellular fluid(ECF). It is a principal cation which determines the osmolality of ECF. This ion helps in maintaining the intravascular volume status of an individual. Nearly 40% of this ion in the body is present in the bone. Sodium balance is regulated in the body by the kidneys and it is the principal site for its excretion. Sodium has a unique property among the electrolytes because water balance determines the sodium balance in the body. Hyponatremia seems to be a very common electrolyte abnormality in hospitalised children. Hyponatremia occurs when there is alternation in the ratio of water to sodium.Hyponatremia can be divided into

- Pseudohyponatremia
- True hyponatremia

PSEUDOHYPONATREMIA:

Here hyper osmolality causes movement of water from intracellular to extracellular space (i.e.) down the osmotic gradient. This type of hyponatremia usually does not cause any symptoms. In this condition measured osmolality is usually normal. The causes of Pseudohyponatremia are

- Hyperglycemia
- Iatrogenic (mannitol, sucrose)

TRUE HYPONATREMIA

True hyponatremia can be broadly divided into three categories as follows

- Hypovolemic hyponatremia
- Hypervolemic hyponatremia
- Euvolemic hyponatremia

HYPOVOLEMIC HYPONATREMIA

This type of hyponatremia occurs due to loss of water along with sodium from the body. The loss of sodium from the body is usually higher than water loss. The water balance in the body may be either negative or positive. The aetiology can be divided into

1. **RENAL LOSS**

- Diuretics
- Osmotic diuresis
- Post obstructive diuresis
- Polyuric phase of ATN
- Proximal RTA
- Tubulointerstitial nephritis
- Lack of aldosterone effect

2. **EXTRA RENAL LOSS**

- GIT losses - diarrhoea, vomiting
- Skin – sweating, burns
- Third space losses

HYPERVOLEMIC HYPONTREMIA

In this type of hyponatremia there is excess of total body water and also there is slight excess of body sodium. There is reduction in effective circulating volume which stimulates ADH secretion which in turn leads to water retention.The aetiology of this type of hyponatremia are

- Congestive cardiac failure
- Liver cirrhosis
- Nephrotic syndrome
- Renal failure
- Sepsis causing capillary leak

EUVOLEMIC HYPONATREMIA:

In this type of hyponatremia there is increase in the amount of total body water along with slight decrease in serum sodium. These group of patients appear normal or may have minimal signs of fluid overload. The important causes of this type of hyponatremia are

- SIADH
- Nephrogenic syndrome of antidiuresis
- Hypothyroidism
- Water intoxication

HYPONATREMIA IN PNEUMONIA

Hyponatremia is a common electrolyte imbalance which occurs in children with pneumonia. Many studies have reported the incidence of hyponatremia around 40 to 45%. The basic pathophysiology is thought to be due to stress induced release of anti-diuretic hormone (ADH). This inappropriate production of ADH produces water retention and hence euvolemic hyponatremia leading to SIADH. These patients do not develop any symptoms unless the hyponatremia is severe. The diagnosis of SIADH occurring in pneumonia can be confirmed by measuring serum electrolytes, serum osmolality, urine sodium and urine osmolality.[2,32-35]

ANTI DIURETIC HORMONE

ADH is a peptide hormone secreted from the posterior pituitary gland. It is basically synthesised in the supraoptic and paraventricular nucleus of the hypothalamus and stored in the posterior pituitary. ADH is secreted as a response to decreased serum osmolality. The main action of this hormone is to retain water in the body preventing its excretion. The major site of action of this hormone is at the distal convoluted tubule and the collecting duct. The hormone binds to V2 receptors located at the basolateral membrane of the epithelial cells of collecting duct. The V2 receptors are G protein coupled receptors. Binding of AVP to V2 receptors causes activation of adenyl cyclase. This activation causes conversion of ATP to c AMP. The increase in the level of c AMP mobilises the AQP-2 channels towards the apical membrane of the epithelium of the tubules. This increases the water reabsorption in the collecting ducts.[36]

SYNDROME OF INAPPROPRIATE ANTIDIURETIC HORMONE

In SIADH there is inappropriate and excess secretion of ADH. Here the secretion of ADH is not inhibited by the decreased serum osmolality and increased total body water (TBW). Since the child is unable excrete water the TBW increases. As a response to increased intravascular volume the kidneys increase the excretion of sodium hence

resulting in mild reduction in body sodium levels. It can be caused by a causes like

- CNS disorders (infections, haemorrhage, trauma, tumour)
- Pulmonary disorders (pneumonia, lung abscess, asthma, positive pressure ventilation etc.)
- Malignant tumours
- Drugs

SIADH is a diagnosis of exclusion because other causes of hyponatremia are to be ruled out before arriving at this diagnosis.[37]

DIAGNOSTIC CRITERIA FOR SIADH

The criteria used in diagnosis of SIADH are

- Serum sodium < 135 mEq/L
- Serum osmolality <280 mOsm/ kg
- Urine sodium > 30 mEq/L
- Urine osmolality > 100 mOsm/kg (usually > plasma)
- Reversal of sodium wasting and correction of hyponatremia with fluid restriction
- Absence of diseases of other systems (renal, adrenal, hypothyroidism, CCF, nephrotic syndrome, liver cirrhosis, dehydration)[38]

HYPONATREMIA CLINICAL PRESENTATION

Hyponatremia decreases the extracellular osmolality. This causes movement of water into the cells to maintain the equilibrium which ultimately causes swelling of the cells. This increase in the cell size does not cause any symptoms in most of the areas except the brain. When the brain tissue swells up it causes increase in intracranial pressure and herniation of brainstem resulting in symptoms. The symptoms of hyponatremia occur only when the sodium level drops acutely. In chronic hyponatremia there are only subtle signs of neurological dysfunction. The symptoms of hyponatremia are

- Headache
- Nausea
- Vomiting
- Lethargy
- Confusion
- Seizures and coma
- Apnoea[38]

TREATMENT

The treatment of hyponatremia depends on the specific aetiology, type of hyponatremia and severity. In general all cases of severe hyponatremia and symptomatic hyponatremia are to be corrected. It is important to remember that rapid correction of hyponatremia can result

in central pontinemyelinolysis which can further aggravate the complications. In SIADH the main method of treatment is fluid restriction. Diuretics can also be used for treatment in SIADH. During correction the rate of fall in serum sodium levels should not exceed 12mEq/ 24 hours.[38-39]

REVIEW OF LITERATURE

Don et al[40] studied the incidence of serum sodium abnormalities in community acquired pneumonia occurring in children. 108 children in whom CAP was confirmed radiologically were included in the study. Serum sodium level was measured in these patients and compared with clinical and laboratory parameters. Aetiology of CAP was confirmed in 97 patients by serology. Out of 108 children 49 (45.4%) had hyponatremia. Among the hyponatremic children 92% had mild hyponatremia. Hyponatremic children had high temperature (38.96 °C vs. 38.45°C, p=0.008); high neutrophil % (78.93% vs. 69.33%, p=0.0001); high WBC count (21,074 vs. 16592, p=0.008); high CRP (168.27 mg/dl vs.104.75 mg/dl, p=0.014); high procalcitonin (22.35 ng/ml vs.6.87 ng/ml, p=0.0001) and low estimated osmolality (263.39 mosm/l vs.272.84 mosm/l, p=0.0001) than normonatremic children. There was no association with plasma glucose, radiological finding or aetiology. The study concluded that hyponatremia was associated with the severity of CAP which was assessed by high temperature, demand for hospitalisation and serum non-specific inflammatory markers.

Glatstein et al[41] conducted a retrospective study to find the link between radiological pattern of CAP and occurence of hyponatremia in children. They reviewed the medical case records and x-rays of 54 children admitted with CAP and had hyponatremia (moderate to severe). The radiologist defined the x- rays into 2 groups lobar segmental and

interstitial. Hyponatremia was more common in lobar segmental pneumonia group 40 (74%) compared with interstitial pneumonia group 14 (26%) (p= 0.0004). They also found no relationship between the radiological pattern of pneumonia and severity of hyponatremia.

Wrotek et al[42] conducted a retrospective study of 312 children (165 boys & 147 girls) admitted with CAP to find out the relation between the severity of CAP and hyponatremia. They divided the children into two groups (greater than and less than 4 years). Clinical findings and serum non-specific inflammatory markers were used to predict the severity of the disease. 104 children were found to have hyponatremia (33.3%). Both groups of children with hyponatremia had high neutrophil % (6.96 vs. 5.73* 10(3)/μL; $p < 0.05$ and 12.46 vs. 8.22*10(3)/μL; $p = 0.01$); > 4 year old group had higher amount of WBC(15.85 vs. 11.0*10(3)/μL; $p = 0.02$) ; < 4 year old group had low lymphocyte (3.74 vs. 4.75*10(3)/μL; $p = 0.02$) than children with normal sodium levels. Hyponatremic children had high temperature (38.6 vs.37.6 °C; $p < 0.01$); high CRP (28.82 mg/L vs. 9.18 mg/L; $p < 0.01$); high procalcitonin (0.31 vs. 0.19 ng/mL): longer duration of hospital stay (9 vs8 days; p=0.01). The study concluded that hyponatremia is a frequent finding in children with CAP and is associated with the severity of disease.

Sakellaropoulou et al[43] did a retrospective study to find out the incidence of hyponatremia in pediatric CAP. The study also aimed to

find out the predictive tools to classify the severity of CAP and its outcome. They reviewed the medical case records of 54 children (4.67 ±2.88 years old) with CAP. Hyponatremia was found in 19/54 (35.2%).Hyponatremia was of mild degree in 18/54 (33.3%) and moderate degree in 1/54 (1.9%). Tachypnea and tachycardia correlated with hyponatremia($z = -1.705$, $p = 0.089$ and $z = -2.664$, $p = 0.007$ respectively). They found a correlation between sodium levels at admission with CRP ($p=0.000$) and WBC count ($p=0.006$). They also observed a negative association between the degree of hyponatremia and length of hospital stay ($z = -3.398$, $p = 0.001$). The study concluded that tachypnea, tachycardia, increased WBC count, increased ESR and CRP are all the risk factors which influence the degree of hyponatremia in children hospitalized with CAP and the outcome.

Nair et al[44] reviewed the medical records of 342 subjects who participated in CAP Standardized Order Set Study retrospectively to find out the incidence of hyponatremia and for analyzing the risk factors for the occurence of hyponatremia. 27.9% patients had hyponatremia (<136 mEq/ L) at admission. Only 4.1% of the subjects had sodium levels < 130 mEq/L. Hyponatremic patients had increased heart rates at admission (100.2 vs.93.2 beats/min $p=0.03$), high leukocytes (15100 vs. 12100; $p < 0.0001$) and class 4 or 5 Pneumonia Severity Index (35.7% vs. 25.1%, $p= 0.05$). This study concluded that hyponatremia is a frequent complication at admission and is also associated with more severe disease, increased

risk for mortality and prolonged hospital stay. This study also concluded that hyponatremia occurs only in few patients during hospitalization and it is not related to the disease severity at the time of admission.

Prasad et al[45] conducted a prospective study in 727 children under 12 years of age who were brought to the pediatric emergency department for hospitalization to find out the frequency, etiology and clinical characteristics of hyponatremia (<130 mEq/L). 29.8% children had hyponatremia. Hyponatremia occurred more frequently in summer (36% ; 123/341) than in winter (24% ; 94/386) [p < 0.001]. Diarrhea and pneumonia were the most common causes of hyponatremia each accounting for 20% cases. Most of the children had dilutional hyponatremia except in diarrhea where it was hypovolemic type. This study concluded that hyponatremia occurs more frequently in sick children seeking PED especially during summer and it should be managed appropriately.

Saxena et al[46] did a prospective study in 500 hospitalized children to find out the etiology and frequency of hyponatremia in children between the ages of 1 month and 14 years. The study was done in 2 seasons- summer and winter. In each season 250 patients were included in the study irrespective of diagnosis. The frequency of hyponatremia in these children was calculated in relation to age, gender, season and diagnosis. 185 children out of 500 children had hyponatremia (37%). The hyponatremia was mild in 130 children (26%), moderate in

39 children (8%) and severe in 16 children (3%). Meningitis/ encephalitis accounted for 20.54% of cases followed by pneumonia which accounted for 12.43% of cases. No significant difference was observed between age, gender or season in the frequency of hyponatremia. The study concluded that hyponatremia is a common finding in different diseases and further studies are needed to unravel the mechanism in different conditions.

Kazunari et al[47] retrospectively studied the medical records of children admitted with RTI to find out the prevalence of hyponatremia. Out of 138 children included in the study only 40 children (28.9%) had hyponatremia. No significant difference in age or length of stay were found between normonatremic and hyponatremic children. They concluded that high prevalence of hyponatremia was found in children with deeper site of inflammation of the respiratory tract.

Shann et al[48] did a prospective study in children admitted with pneumonia and bacterial meningitis. They found that decreased serum sodium levels were seen in 33/73 children with pneumonia (45%) and 10/20 children with meningitis (50%).

STUDY JUSTIFICATION

- Hyponatremia is the most common electrolyte disturbance occurring in children with pneumonia.
- Hyponatremia if not treated appropriately can lead to many complications.
- Inappropriate fluid therapy in children with hyponatremia may lead to serious adverse effects in children.
- Only very few studies in paediatric population have been published in the recent years at international levels.
- Moreover studies in paediatric population are lacking especially from southern part of India

OBJECTIVES OF THE STUDY

The aim of the study is to find out the incidence of hyponatremia in pneumonia and to find out whether it could be used as a predictive tool to assess the severity of pneumonia in children hospitalised with community acquired pneumonia between 2 months and 5 years of age.

MATERIALS AND METHODS

STUDY DESIGN

- Descriptive study

STUDY SETTING

- Medical wards of ICH&HC

STUDY PERIOD

- February 2015 to August 2015

TIMELINE

DATA COLLECTION - February 2015 to July 2015

DATA ANALYSIS AND MANUSCRIPT PREPARATION -August 2015

SUBMISSION OF REPORT – September 2015

STUDY POPULATION

Children with radiologically confirmed pneumonia admitted as inpatients in the medical wards of ICH&HC who meet the inclusion criteria.

SAMPLE SIZE

120 Patients

INCLUSION CRITERIA

- Children aged 2 months to 5 years.
- Symptoms of LRI (fever, increased respiratory rate, chest retraction).
- X ray showing evidence of pneumonia

EXCLUSION CRITERIA

- Chronic diseases involving other systems.
- Previously treated with intravenous fluids.
- Chronic drug intake

SEVERITY OF PNEUMONIA

The severity of pneumonia is classified according to British Thoracic Society Guidelines. The classification divides the children into two age groups (infants and older children). The severity of pneumonia is classified into 2 groups as mild to moderate and severe.

BRITISH THORACIC SOCIETY CLASSIFICATION[26]

The severity assessment is as given in the table

	MILD TO MODERATE	SEVERE
INFANTS	TEMP < 38.5 C RESP RATE < 50/MIN MILD RECESSION TAKING FULL FEEDS	TEMP > 38.5 C RESP RATE >70/ MIN MODERATE TO SEVERE RECESSION NASAL FLARE SPO2 < 92% OR CYANOSIS INTERMITTENT APNOEA NO FEEDING TACHYCARDIA CRT > 2 SEC
OLDER CHILDREN	TEMP < 38.5 C RESP RATE < 50/MIN MILD BREATHLESSNESS NO VOMITTING	TEMP > 38.5 C RESP RATE >50/ MIN SEVERE DIFFICULTY IN BREATHING NASAL FLARE SPO2 < 92% OR CYANOSIS GRUNT DEHYDRATION SIGNS TACHYCARDIA CRT > 2 SEC

HYPONATREMIA[39]

Serum sodium level less than 135 mEq/L is taken as hyponatremia. The severity of hyponatremia is classified as

1. MILD (131 to 134)
2. MODERATE (126 TO 130)
3. SEVERE (125 and less)

STUDY MANOUVERE

1. Children who satisfied the inclusion criteria were recruited into the study.
2. Informed written consent was obtained from the parents of the study subjects.
3. The baseline demographic characteristics and clinical characteristics were obtained from all the children at the time of admission after detailed history taking and clinical examination.
4. Temperature of the children was measured at the axilla using digital thermometer.
5. Oxygen saturation was measured using Nelcor pulse oximeter.
6. Routine blood investigations like Complete blood count, Renal function tests, Serum electrolytes, Random blood sugar, C reactive protein, Blood culture etc. were drawn from the patient and sent without any delay on the day of admission before commencing any treatment.
7. Complete blood counts were analysed using an auto analyser.
8. The blood samples were analysed using Erba Manihier EM 200 auto analyser at the biochemistry lab.

9. Serum sodium and potassium were measured by ISE(ion selective electrode) method. Serum creatinine was measured using Jaffe's kinetic method and serum urea by enzymatic method(Glutamate dehydrogenase). Random blood sugar was measured by glucose oxidase peroxidase method. Urine spot sodium was measured by ISE (ion selective electrode) method.Urine osmolality was measured using freezing point depression method.
10. All the investigations were collected and the values were documented
11. The total count, differential count and platelet count were interpreted based on the values used in the study definition.
12. Hyponatremia was graded according to the definition with the collected serum sodium values.
13. Estimated serum osmolality was calculated for all the patients in the study using random blood sugar, serum sodium and urea.

    Osmolality = 2 x Na^+ + Urea / 6 + Glucose/18
14. In hyponatremic children additional investigations like urine spot sodium and spot urine osmolality were sent.
15. All the biochemical investigations were interpreted based on the values used in the study definition.

16. Fluids were restricted to two third maintenance for all children with hyponatremia.
17. In hyponatremic children repeat serum sodium values were sent again on day 4 of admission.
18. All the other parameters were compared to the severity of hyponatremia.

STUDY DEFINITION

1. WBC COUNT

AGE OF THE CHILD	TOTAL COUNT	NEUTROPHIL(%)
2mon to 5 mon	6000 - 18000	30
6mon to 5 years	6000 - 15000	45

2. PLATELET COUNT

NORMAL	1.5 lakhs – 4.5 lakhs
THROMBOCYTOPENIA	Less than 1.5 lakhs
REACTIVE THROMBOCYTOSIS	Greater than 5 lakhs

3. SERUM SODIUM

NORMAL	135 – 145 mEq/L
MILD HYPONATREMIA	131 – 134 mEq/L
MODERATE HYPONATREMIA	126 – 130 mEq/L
SEVERE HYPONATREMIA	< 126 mEq/L

4. RENAL FUNCTION TEST

SERUM UREA	11 – 39 mg/dl
SERUM CREATININE	0.3 – 0.7 mg/dl

5. SERUM OSMOLALITY

NORMAL	280 – 290mOsm/kg
DECREASED	<280mOsm/kg

6. URINE SPOT SODIUM

Increased >30 mEq/L

7. URINE OSMOLALITY

In patients with hyponatremia urine osmolality > 100 mOsm/kg was considered elevated.

STATISTICAL ANALYSIS

- All the data were entered in the Microsoft Excel spread sheet and analysed using SPSS Software version 20.0.
- The primary outcome was expressed as proportion.
- Chi Square test was used to determine the association between outcome variable and dependent variable. P value less than 0.05 was considered significant.

ETHICAL CONSIDERATIONS

- Ethical clearance from the institutional review board was obtained.
- Informed written consent was obtained from the parents of the study subjects.
- Strict confidentiality of data was maintained throughout the study.

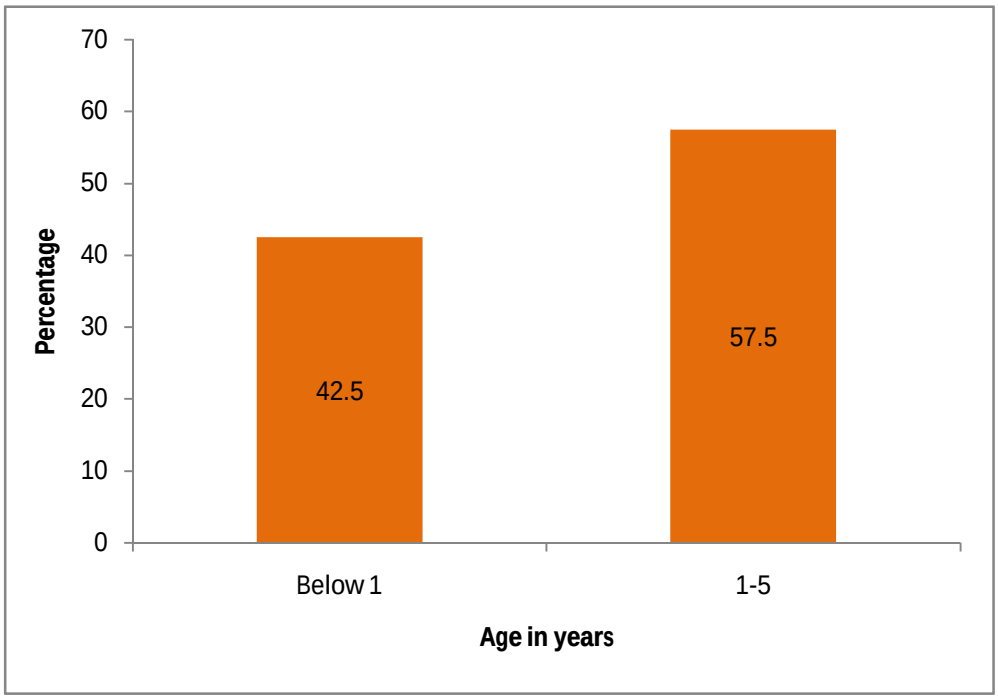
RESULTS AND OBSERVATION

120 children who satisfied the inclusion criteria were recruited into the study.

TABLE 1: AGE DISTRIBUTION

Age in years	Frequency	Percent
Below 1	51	42.5
1-5	69	57.5
Total	120	100.0

BAR DIAGRAM - 1

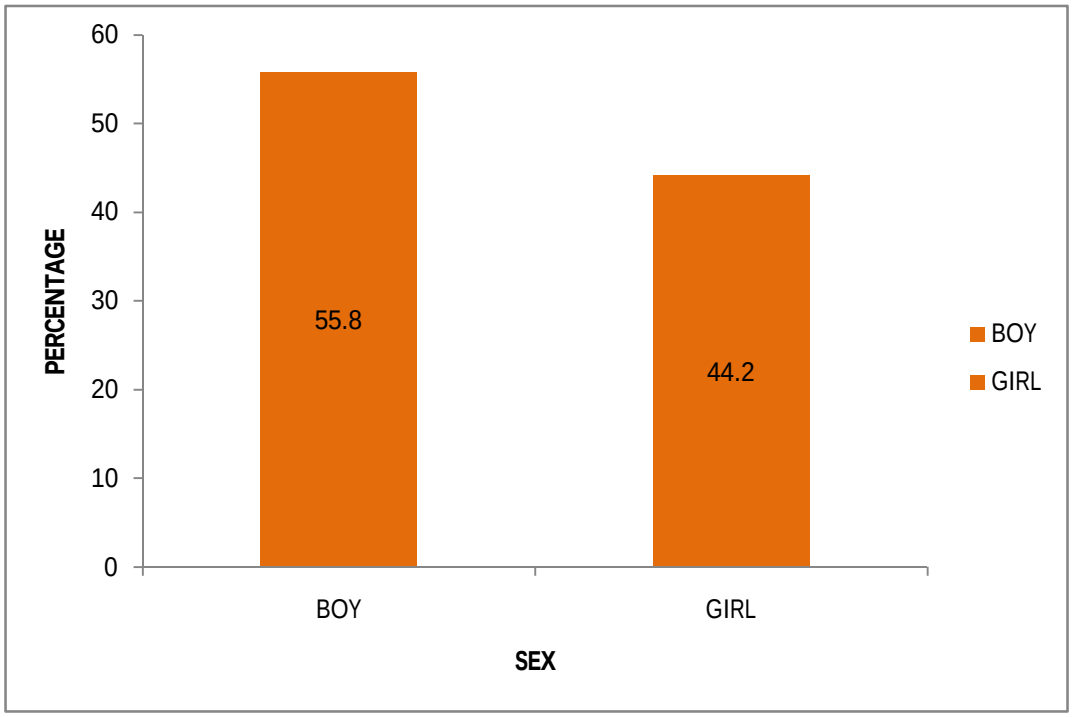


The above bar diagram and table shows that in the study around 42.5% of children were under 1 year of age and around 57.5% were between 1 to 5 years of age.

TABLE 2: SEX DISTRIBUTION

Sex	Frequency	Percent
Male	67	55.8
Female	53	44.2
Total	120	100.0

BAR DIAGRAM - 2

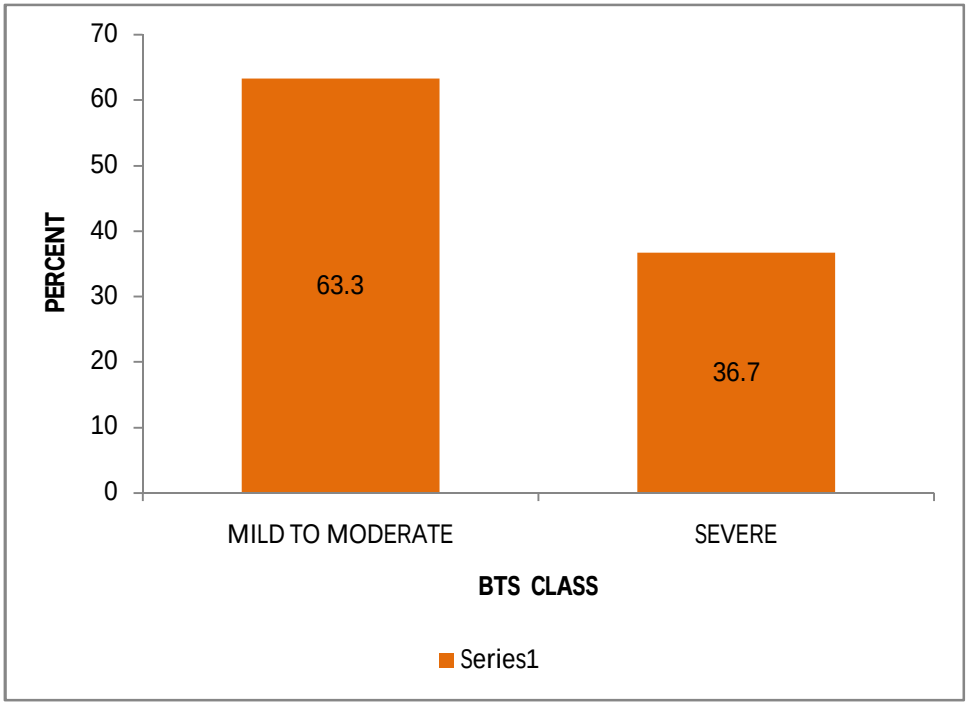


The above table and bar diagram shows that in the study 55.8% were boys and 44.2 % were girls.

TABLE 3: BRITISH THORACIC SOCIETY CLASSIFICATION

BTS Class	Frequency	Percent
Mild to moderate	76	63.3
Severe	44	36.7
Total	120	100.0

BAR DIAGRAM - 3

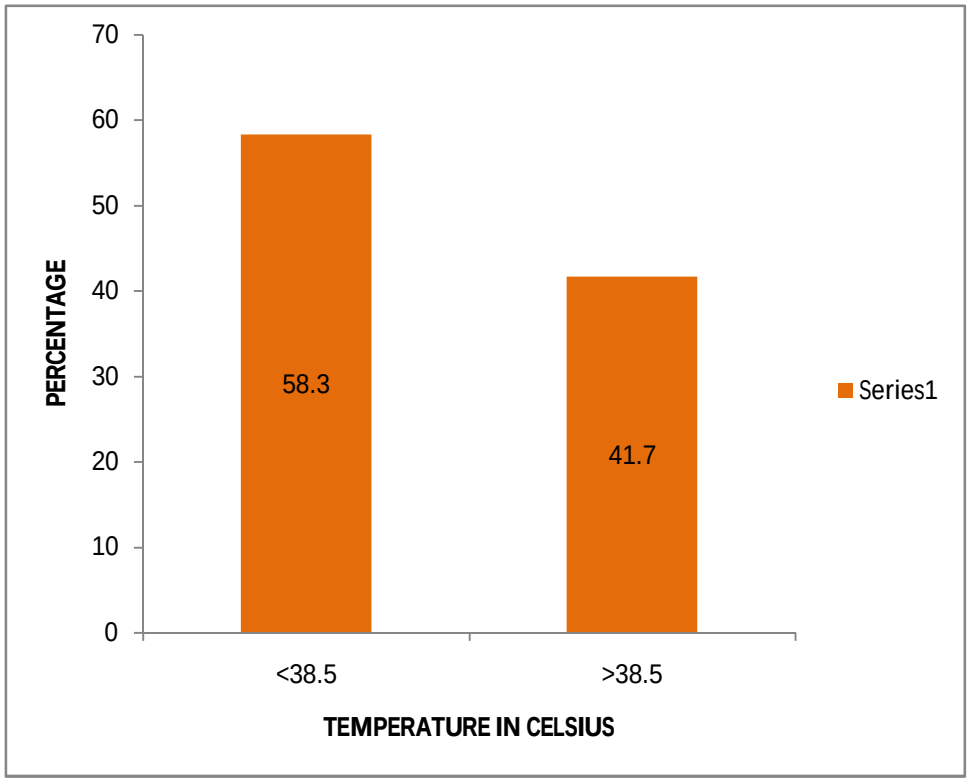


The above bar diagram and table shows that around 63.3% of children belonged to mild to moderate pneumonia and around 36.7% of children belonged to severe pneumonia in the study.

TABLE 4: INITIAL TEMPERATURE

Temperature	Frequency	Percent
<38.5°C	70	58.3
> 38.5°C	50	41.7
Total	120	100.0

BAR DIAGRAM - 4

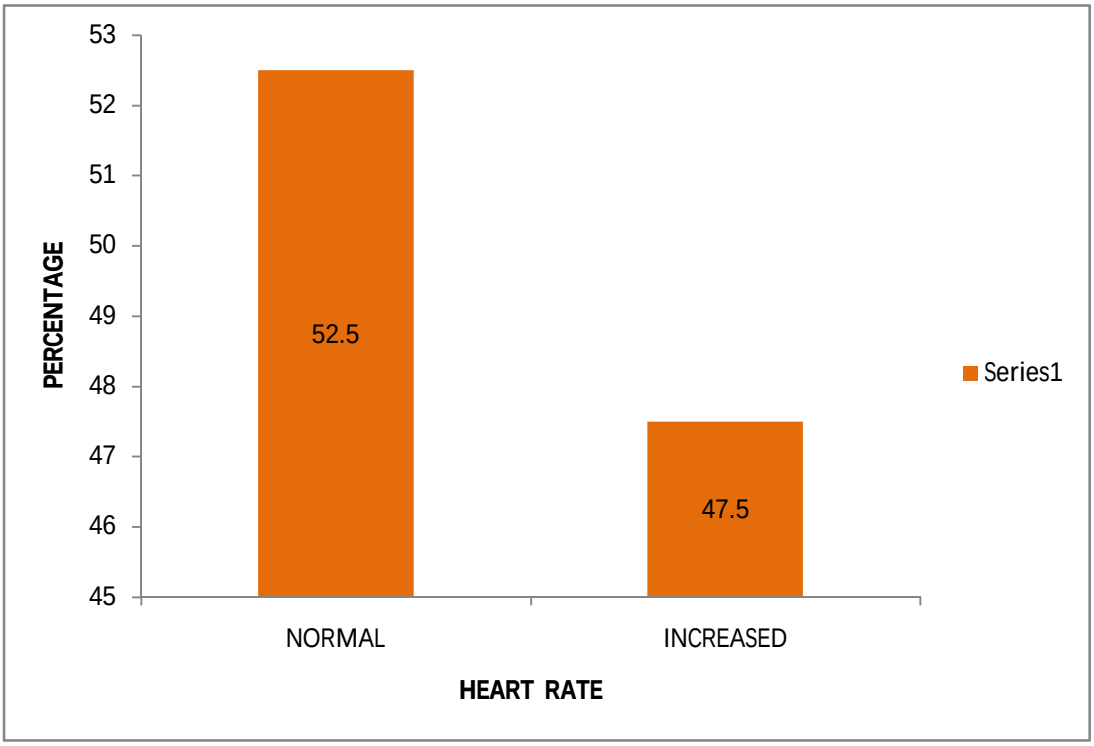


The above bar diagram and table shows that 58.3% of children had high initial temperature (> 38.5) and 41.7% had temperature less than 38.5 degree Celsius.

TABLE 5: HEART RATE

Heart Rate	Frequency	Percent
Normal	63	52.5
Increased	57	47.5
Total	120	100.0

BAR DIAGRAM - 5

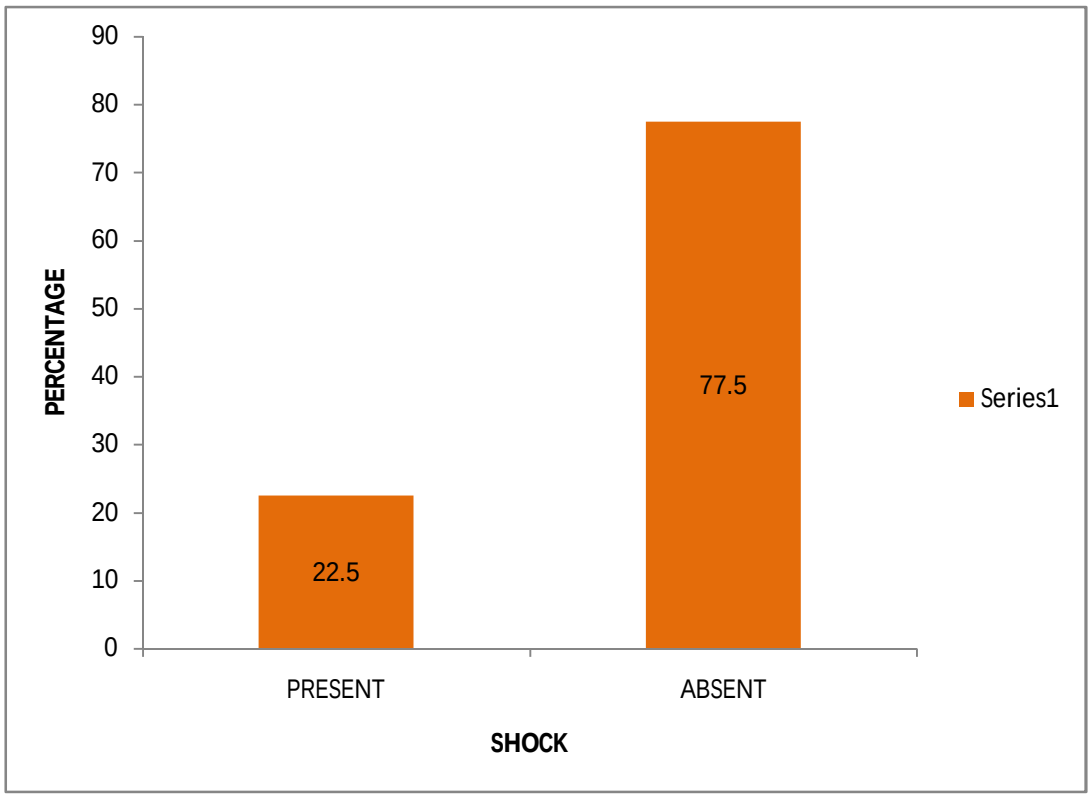


The above bar diagram and table shows that around 52.5% of children had normal heart rates at admission while 47.5% of children had tachycardia at the time of admission.

TABLE 6: SHOCK

Shock	Frequency	Percent
Absent	93	77.5
Present	27	22.5
Total	120	100.0

BAR DIAGRAM - 6

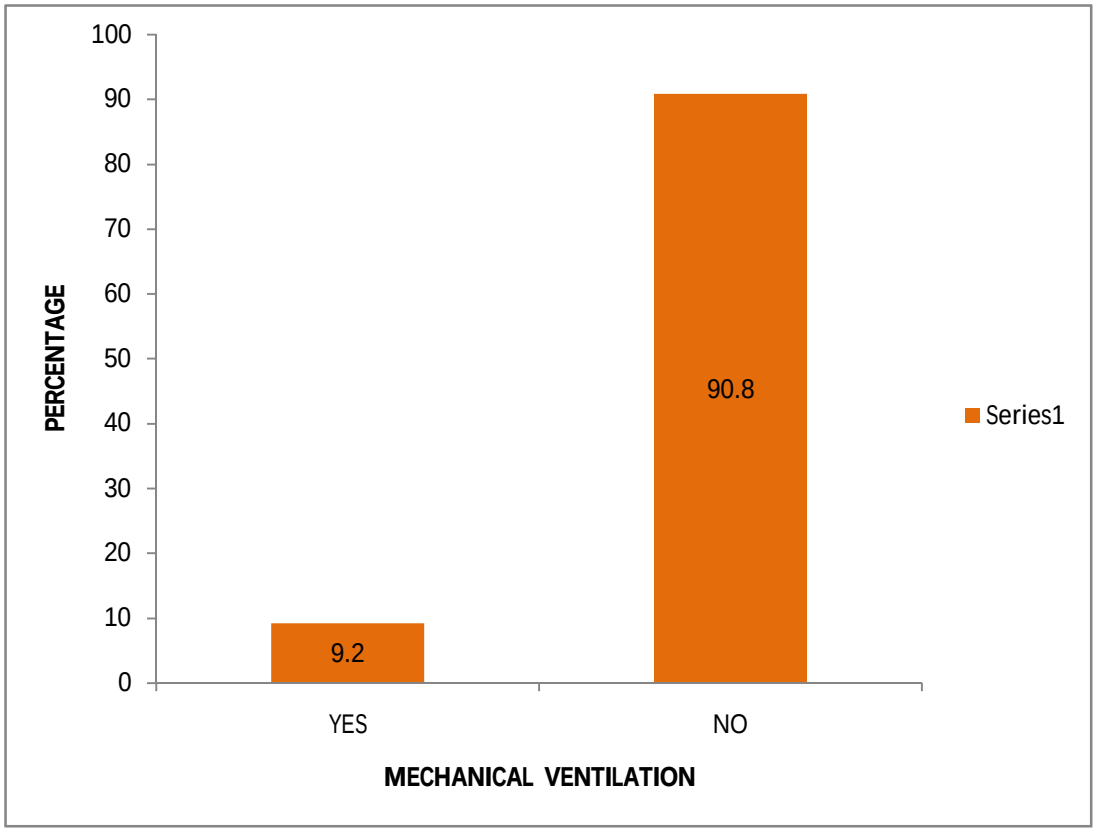


The above table and bar diagram shows that around 22.5% of children included in the study had shock initially at the time of admission.

TABLE 7: MECHANICAL VENTILATION

Mechanical ventilation	Frequency	Percent
No	109	90.8
Yes	11	9.2
Total	120	100.0

BAR DIAGRAM - 7

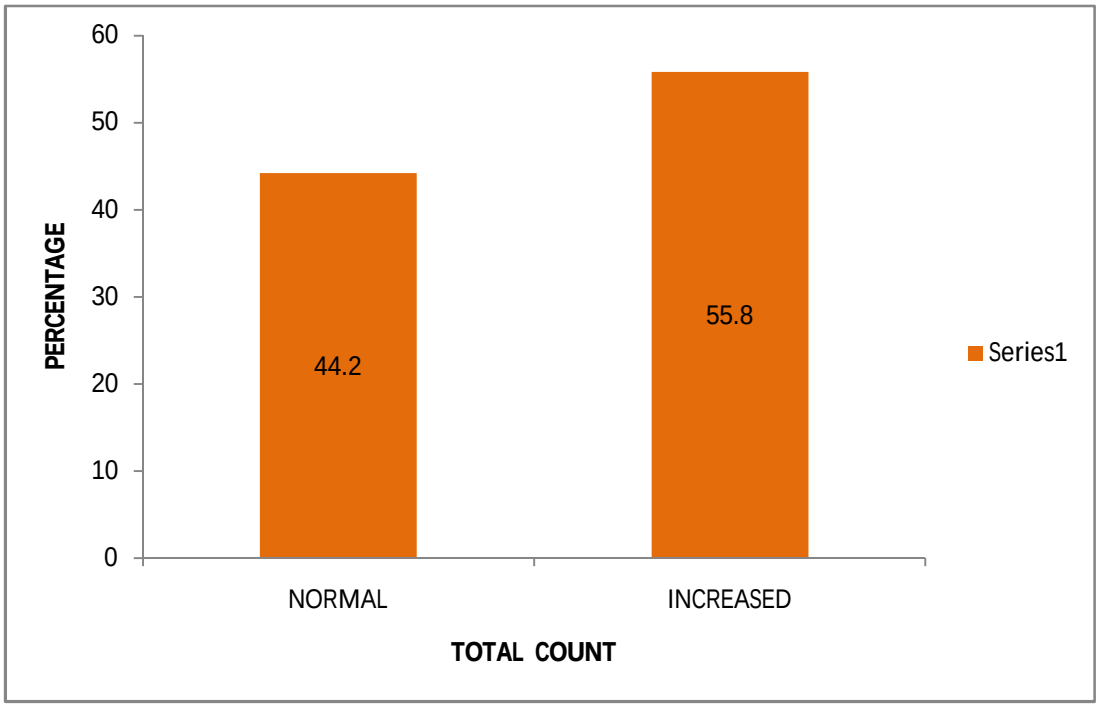


The above table and bar diagram shows that around 9.2% of children enrolled in the study required mechanical ventilation.

TABLE 8: TOTAL COUNT

Total count	Frequency	Percent
Normal	53	44.2
Increased	67	55.8
Total	120	100.0

BAR DIAGRAM - 8

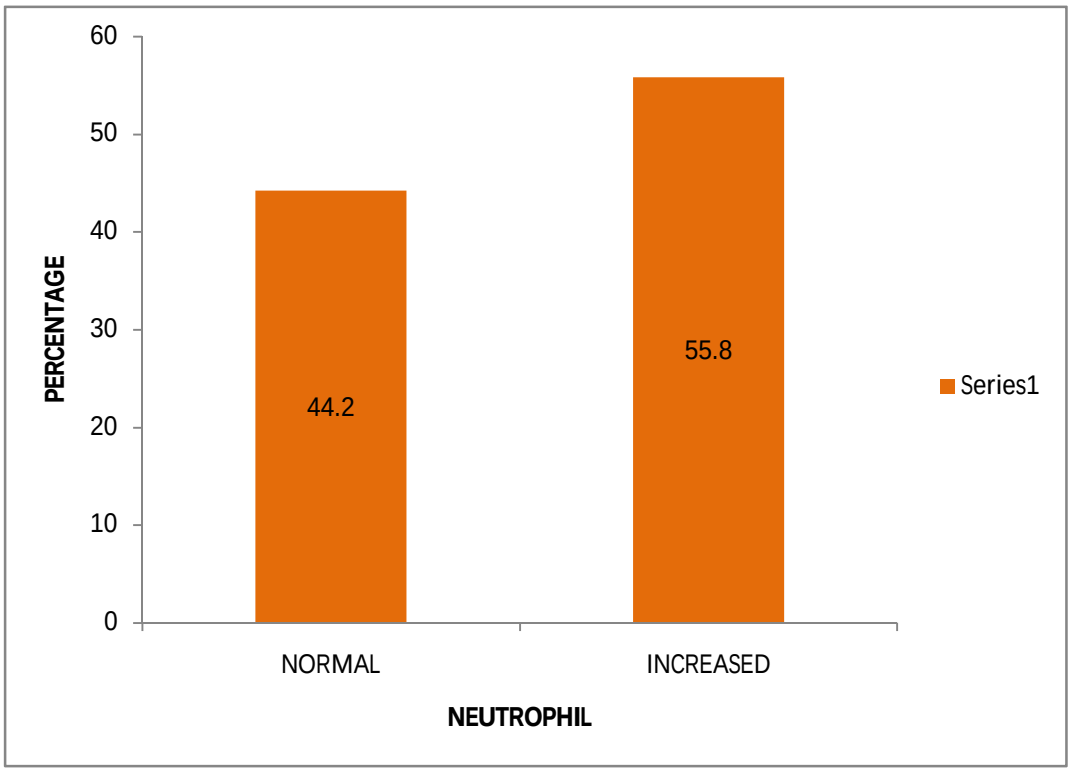


The above table shows that around 44.2% of children had normal counts and around 55.8% of children had increased counts at the time of admission.

TABLE 9: NEUTROPHIL COUNT

Neutrophil count	Frequency	Percent
Normal	53	44.2
Increased	67	55.8
Total	120	100.0

BAR DIAGRAM – 9

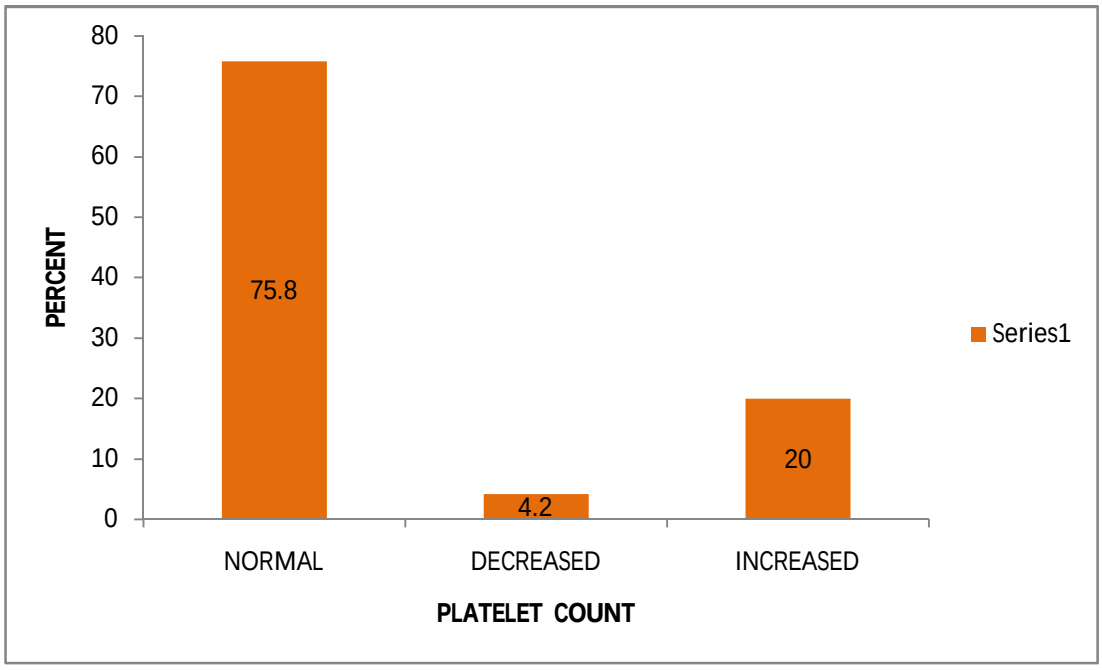


The above table and bar diagram shows that around 55.8% of children had increased neutrophil count at the time of admission.

TABLE 10 : PLATELET

Platelet count	Frequency	Percentage
Normal	91	75.8
Decreased	5	4.2
Increased	24	20.0

BAR DIAGRAM - 10:

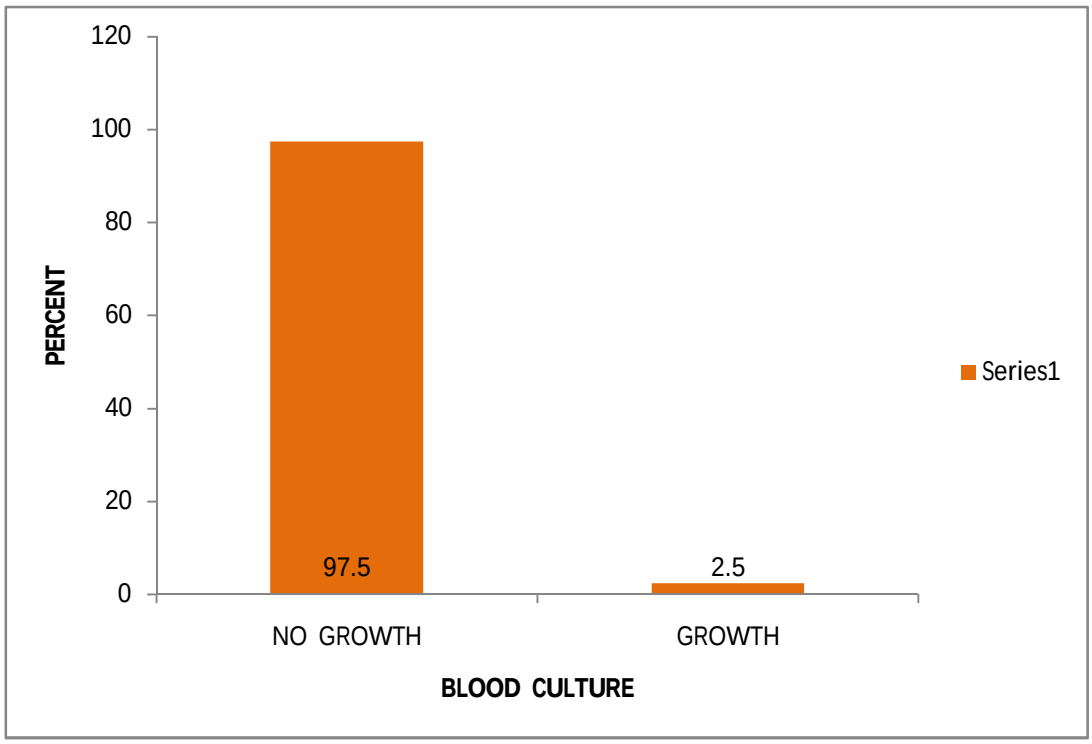


The above table and bar diagram shows that thrombocytopenia was seen in 4.2% of children and reactive thrombocytosis was seen in 20% of children**.**

TABLE 11: BLOOD CULTURE

Blood culture	Frequency	Percent
No growth	117	97.5
Growth	3	2.5
Total	120	100.0

BAR DIAGRAM - 11

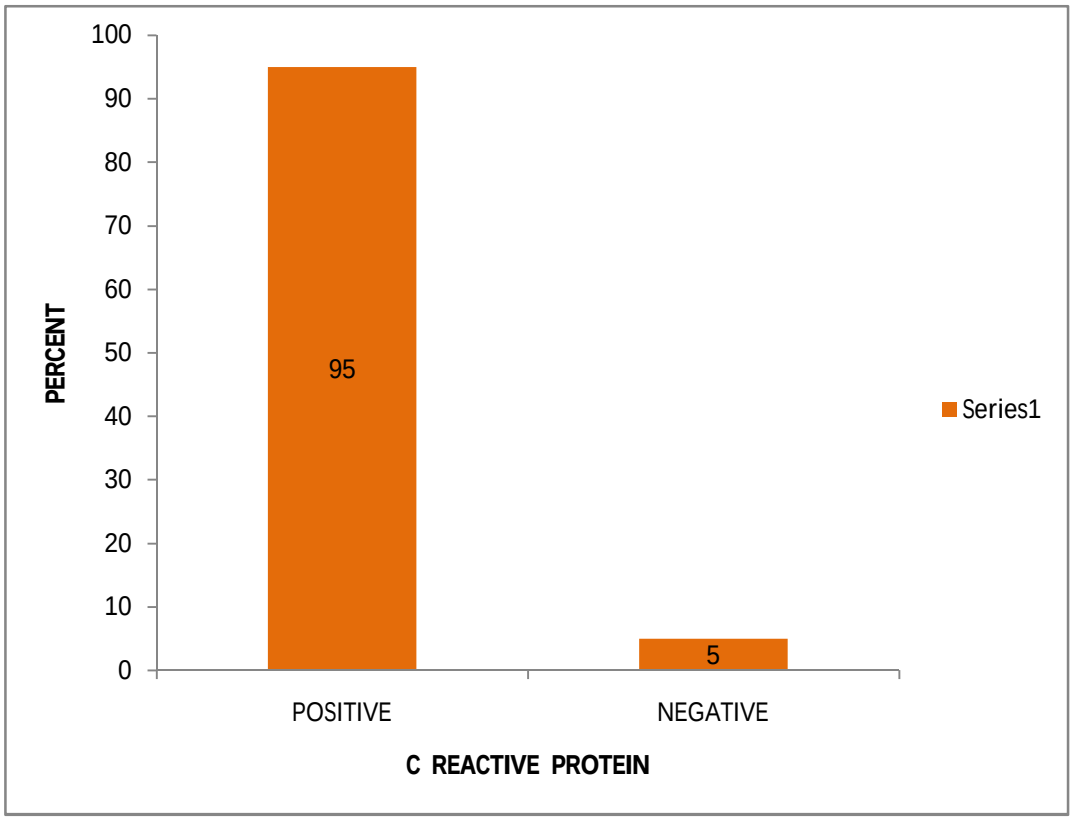


The above table and bar diagram shows that only 2.5% of children showed positive blood cultures.

TABLE 12: C- REACTIVE PROTEIN

C reactive protein	Frequency	Percent
Negative	6	5.0
Positive	114	95.0
Total	120	100.0

BAR DIAGRAM - 12

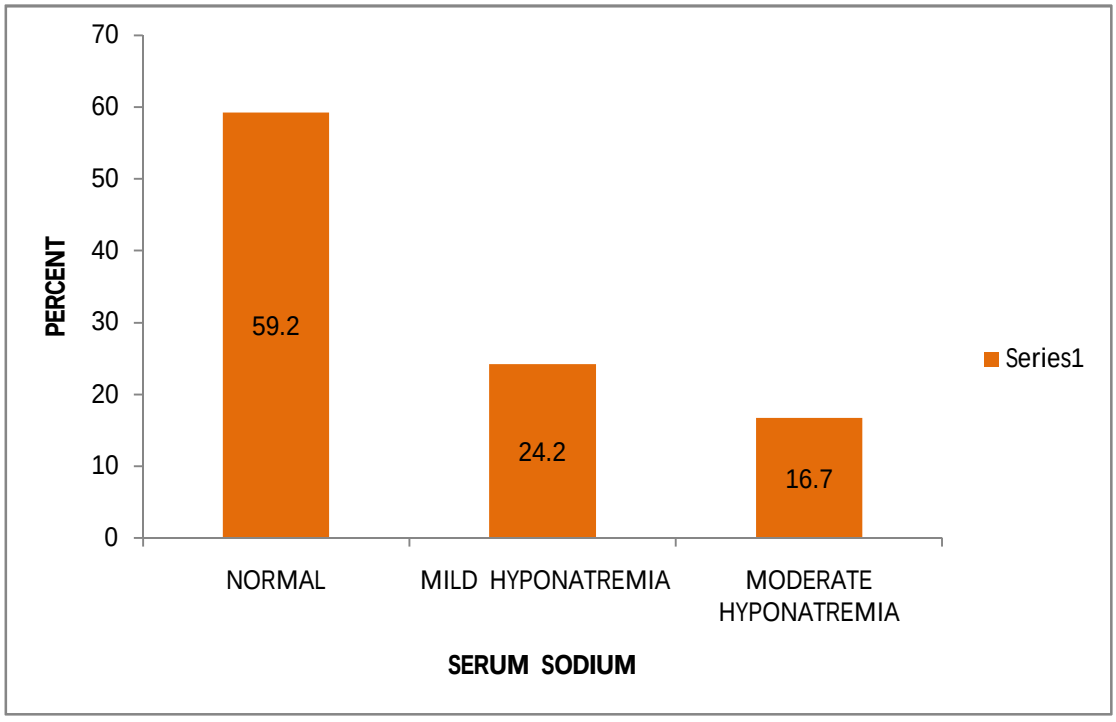


The above bar diagram and table shows that 95% of children showed positive CRP and 5% of children showed negative result.

TABLE 13: SERUM SODIUM

Serum sodium	Frequency	Percent
Normal	71	59.2
Mild hyponatremia	29	24.2
Moderate hyponatremia	20	16.7
Total	120	100.0

BAR DIAGRAM - 13

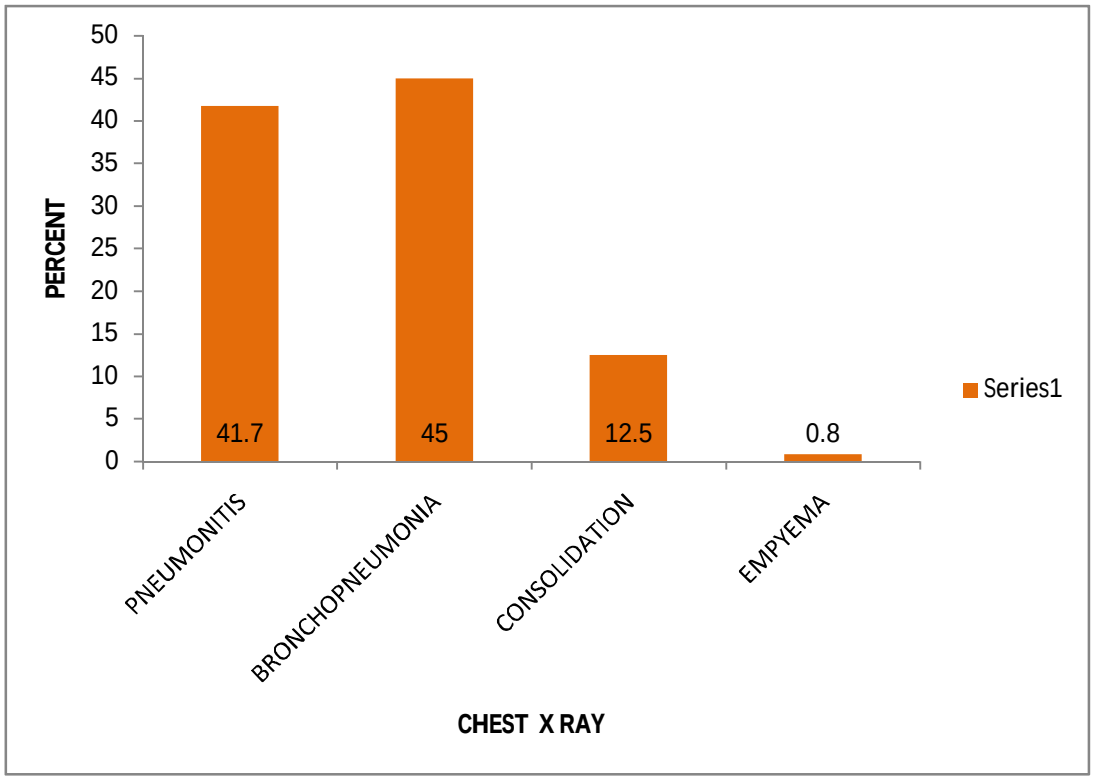


The above bar diagram and table shows that 59.2% of children had normal sodium values at admission. Mild hyponatremia was seen in 24.2% of children and moderate hyponatremia was seen in 16.7% of children.

TABLE 14: CHEST X- RAY

Chest X- ray	Frequency	Percent
Pneumonitis	50	41.7
Bronchopneumonia	54	45.0
Consolidation	15	12.5
Empyema	1	0.8
Total	120	100.0

BAR DIAGRAM – 14

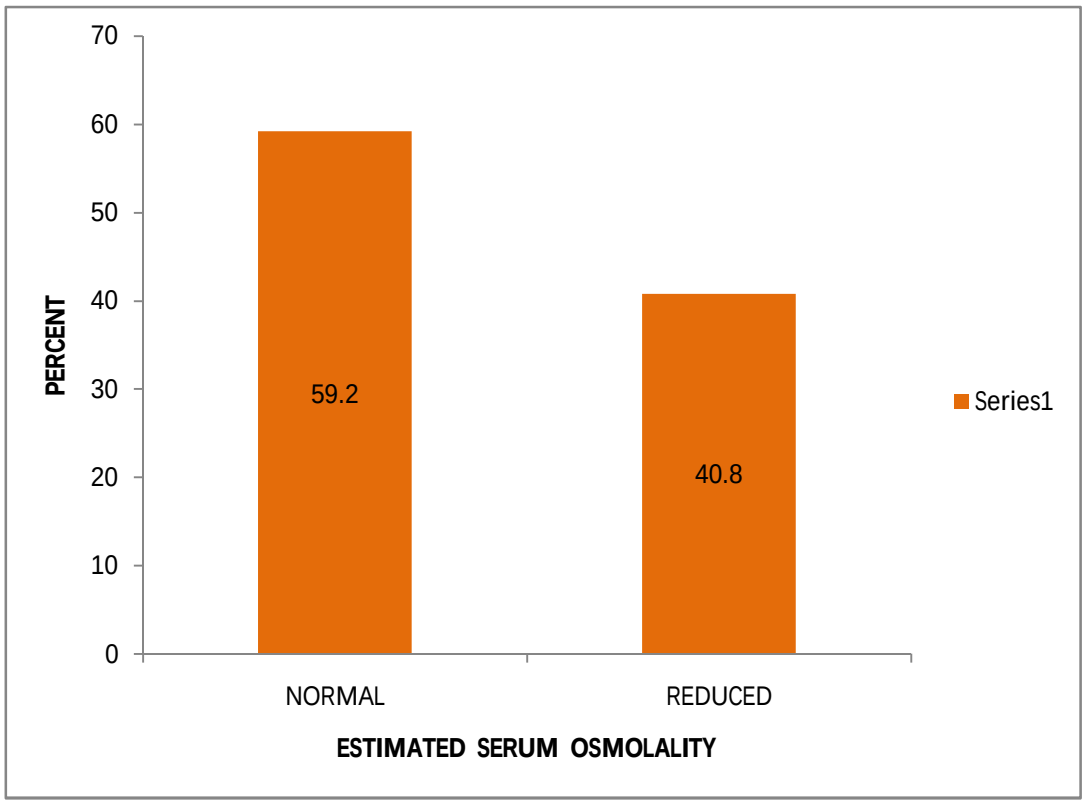


The above table and bar diagram shows that of the 120 children 41.7% had pneumonitis, 45% had bronchopneumonia, 12.5% had consolidation and 0.8% had empyema.

TABLE 15: ESTIMATED SERUM OSMOLALITY

Estimated serum osmolality	Frequency	Percent
Reduced	49	40.8
Normal	71	59.2
Total	120	100.0

BAR DIAGRAM - 15

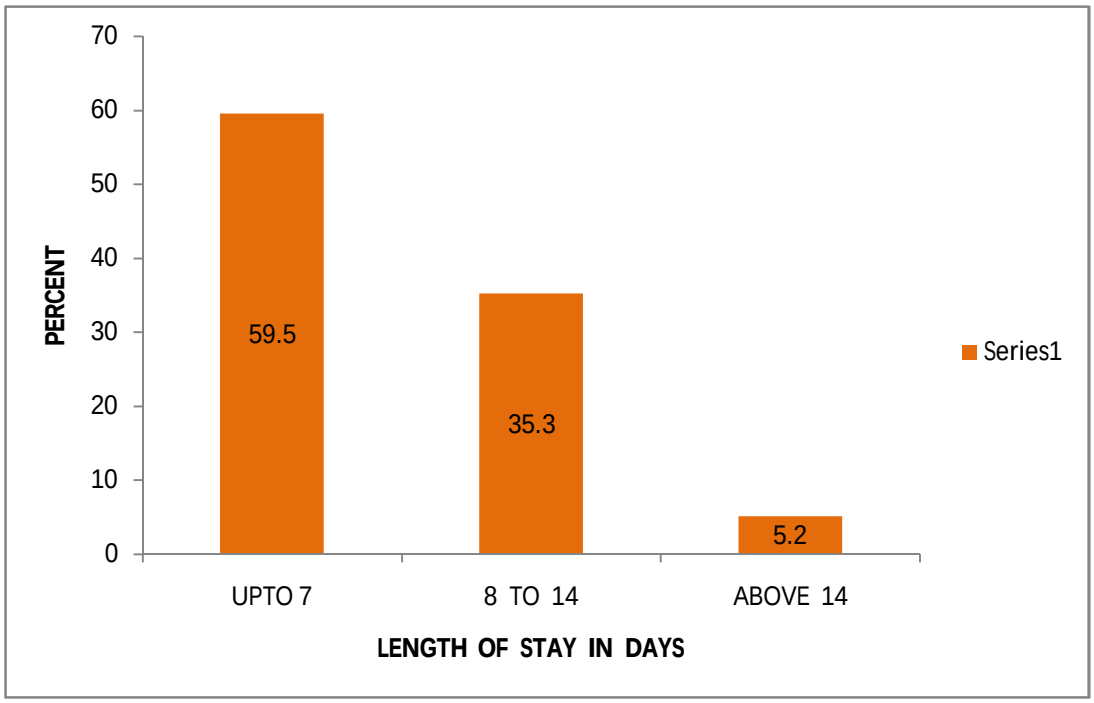


The above table and bar diagram shows that 59.2% had normal serum osmolality and 40.8% had reduced serum osmolality.

TABLE 16: LENGTH OF STAY

Days	Frequency	Percent
Up to 7	69	59.5
8-14	41	35.3
Above 14	6	5.2
Total	116	100.0

BAR DIAGRAM – 16

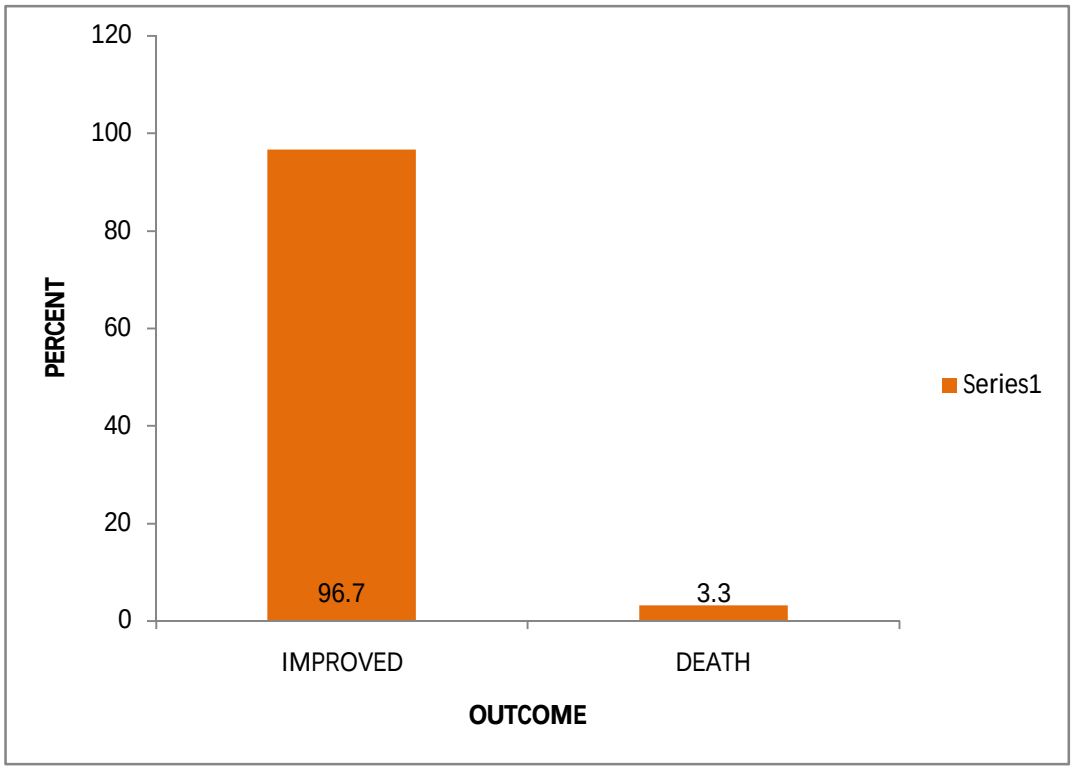


The above table and bar diagram shows that 59.5% of children required up to 7 days of hospitalisation, 35.3% required up to 14 days of hospitalisation and 5.2% required more than 14 days of hospitalisation (4 mortality excluded).

TABLE 17: OUTCOME

Outcome	Frequency	Percent
Improved	116	96.7
Death	4	3.3
Total	120	100.0

BAR DIAGRAM - 17

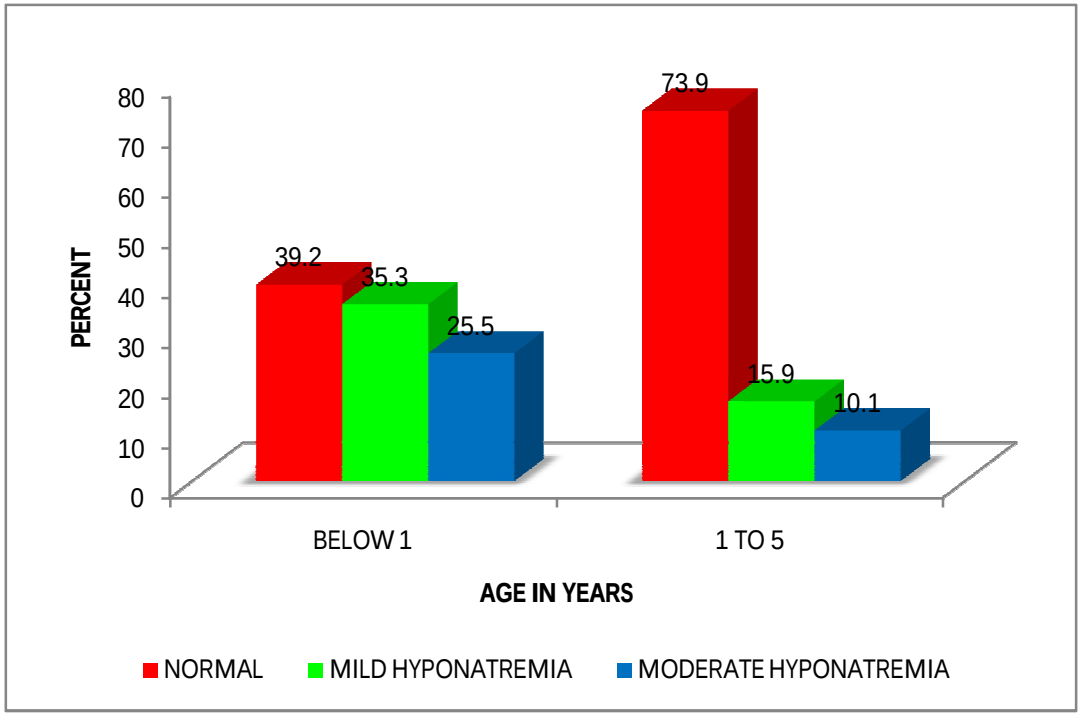


The above table and bar diagram shows that 96.7% of children were discharged and 3.3% expired.

CROSSTABLE 1: COMPARISON OF AGE VERSUS SERUM SODIUM

Age in years	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Below 1	20 (39.2%)	18 (35.3%)	13 (25.5%)	51 (100.0%)	**0.001****
1-5	51 (73.9%)	11 (15.9%)	7 (10.1%)	69 (100.0%)	
Total	71 (59.2%)	29 (24.2%)	20 (16.7%)	120 (100.0%)	

BAR DIAGRAM – 1

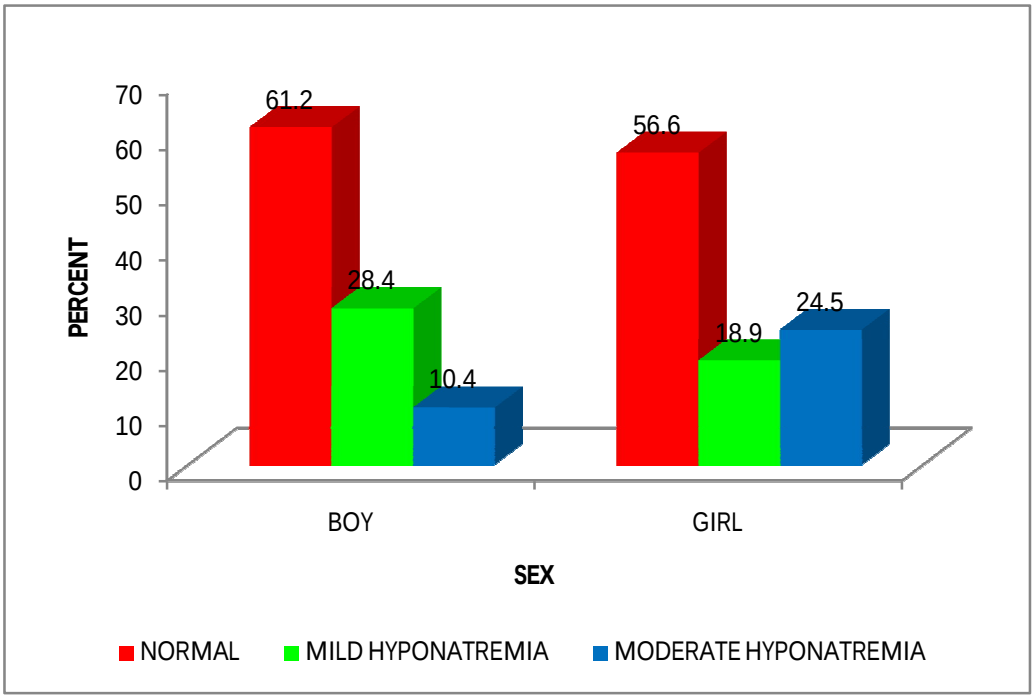


The above table shows that hyponatremia was more common in young infants ($p = 0.001$).

CROSSTABLE 2:COMPARISON OF SEX VERSUS SERUM SODIUM

Sex	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Male	41 (61.2%)	19(28.4%)	7(10.4%)	67(100.0%)	
Female	30(56.6%)	10(18.9%)	13(24.5%)	53(100.0%)	**0.094**
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 2

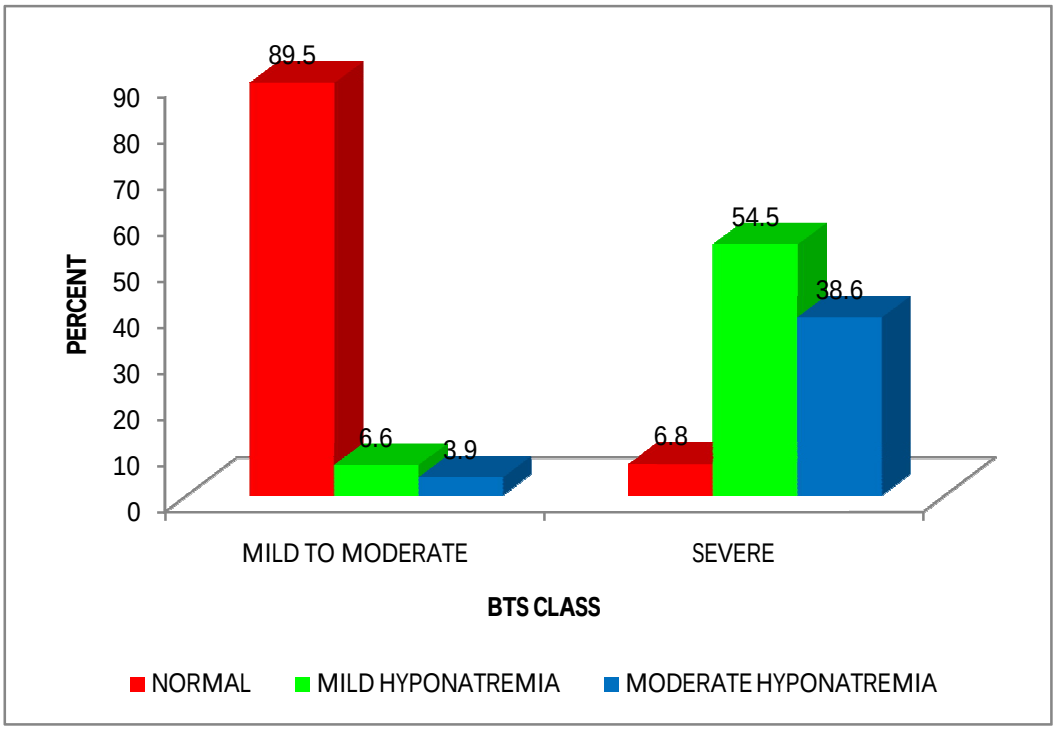


Sex related difference in distribution of hyponatremia is not statistically significant (0.094).

CROSSTABLE 3: COMPARISON OF BRITISH THORACIC SOCIETY CLASSIFICATION VERSUS SERUM SODIUM

BTS Class	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Mild to moderate	68(89.5%)	5(6.6%)	3(3.9%)	76(100.0%)	**<0.001****
Severe	3(6.8%)	24(54.5%)	17(38.6%)	44(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 3

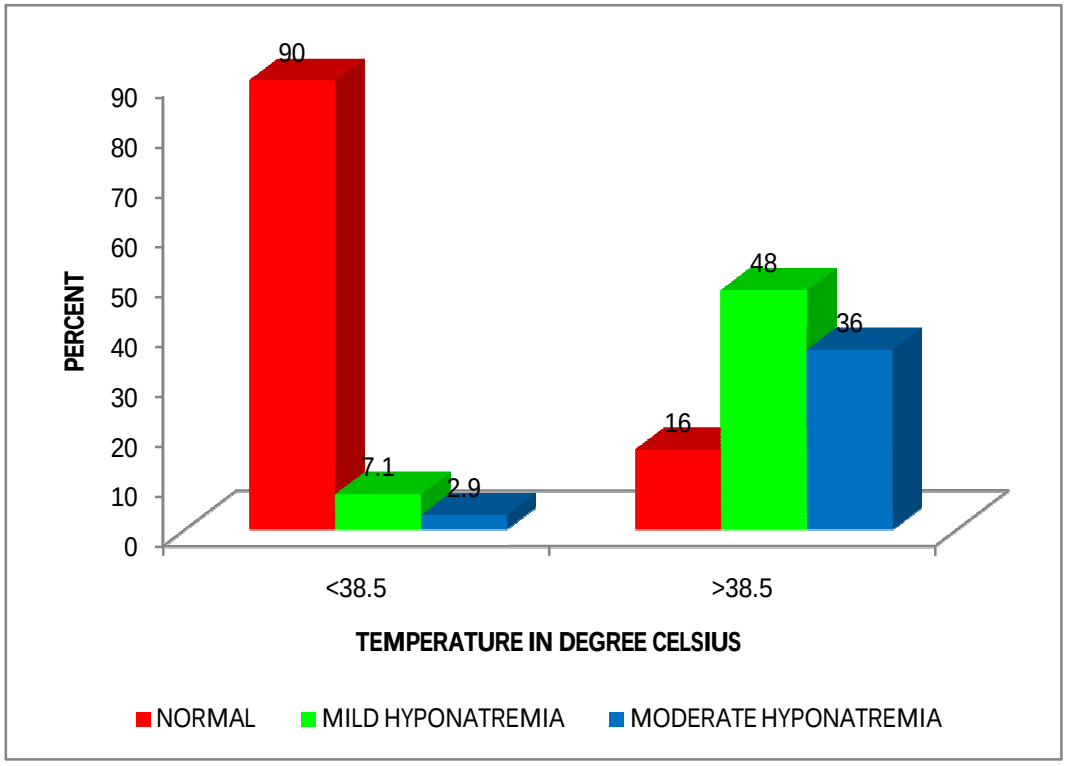


The above table shows that hyponatremia was associated with severe pneumonia in children ($p < 0.001$).

CROSSTABLE 4: COMPARISON OF TEMPERATURE VERSUS SERUM SODIUM

Temperature	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
<38.5 degree Celsius	63(90.0%)	5(7.1%)	2(2.9%)	70(100.0%)	<0.001**
> 38.5 degree Celsius	8(16.0%)	24(48.0%)	18(36.0%)	50(100.0%)	
Total	71(59.2%)	29(24.2%)	20 (16.7%)	120 (100.0%)	

BAR DIAGRAM - 4

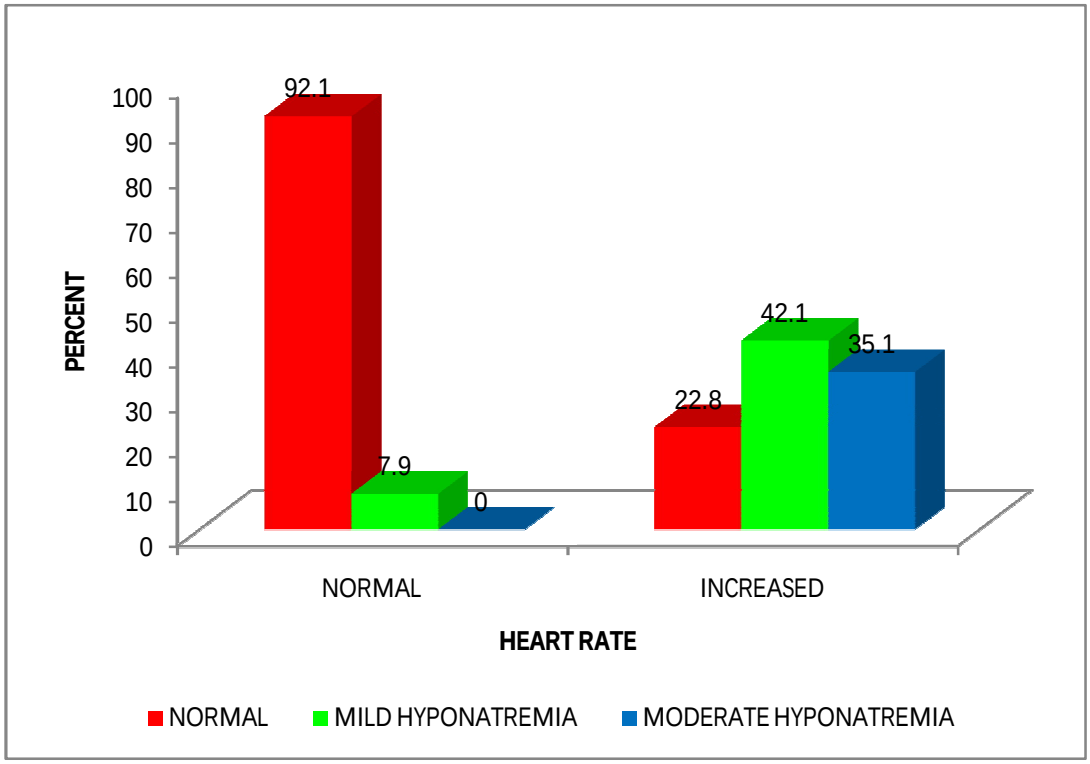


Initial high temperature was associated with hyponatremia (p< 0.001)

CROSSTABLE 5: COMPARISON OF HEART RATE VERSUS SERUM SODIUM

Heart rate	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Normal	58(92.1%)	5 (7.9%)	0 (.0%)	63(100.0%)	**<0.001****
Increased	13(22.8%)	24 (42.1%)	20 (35.1%)	57 (100.0%)	
Total	71 (59.2%)	29 (24.2%)	20 (16.7%)	120 (100.0%)	

BAR DIAGRAM - 5

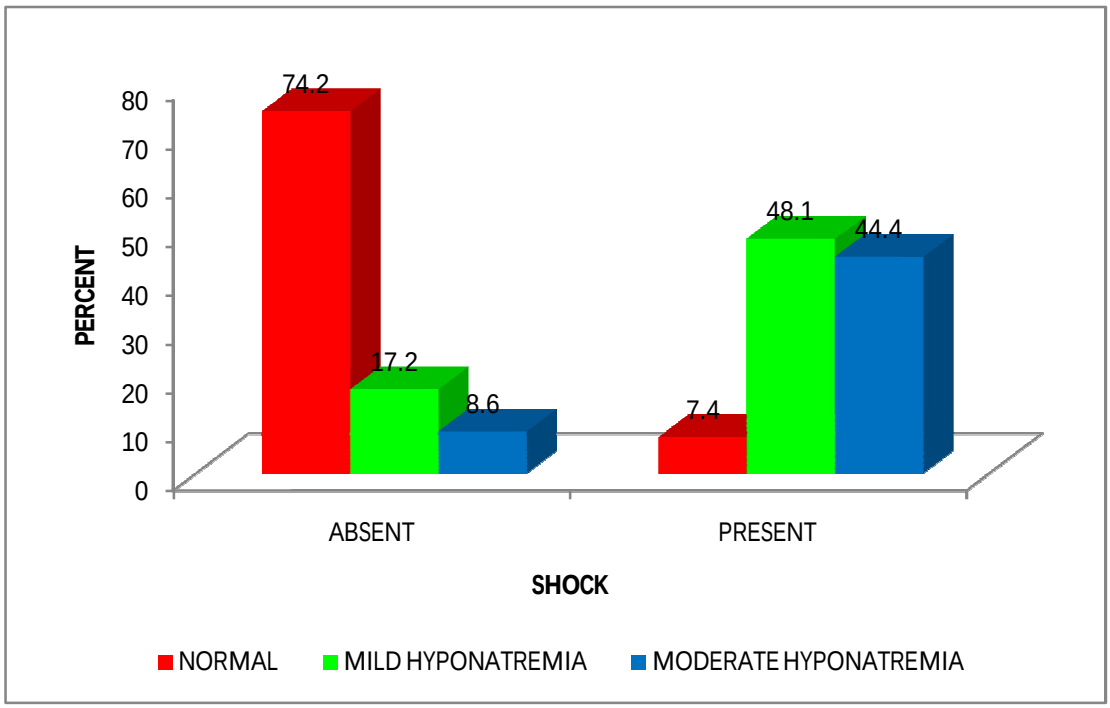


Initial tachycardia was associated with hyponatremia ($p < 0.001$)

CROSSTABLE 6- COMPARISON OF SHOCK VERSUS SERUM SODIUM

Shock	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Absent	69(74.2%)	16(17.2%)	8(8.6%)	93(100.0%)	**<0.001****
Present	2(7.4%)	13(48.1%)	12(44.4%)	27(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 6

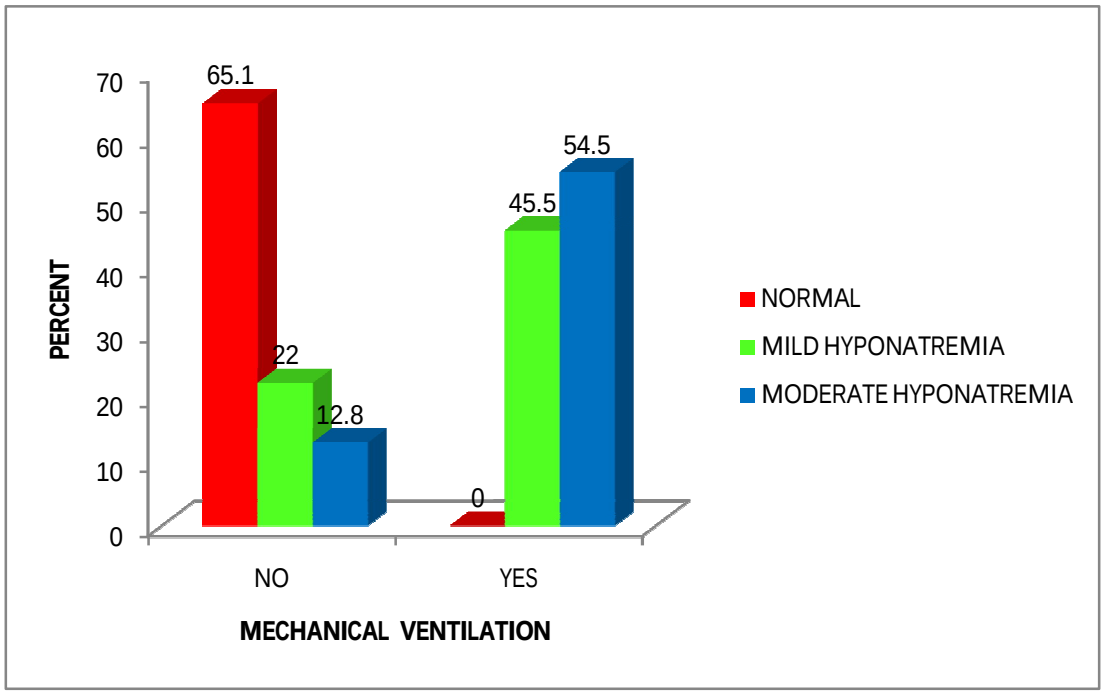


Hyponatremia was more common in children with shock ($p < 0.001$).

CROSSTABLE 7- COMPARISON OF MECHANICAL VENTILATION VERSUS SERUM SODIUM

Mechanical ventilation	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
No	71(65.1%)	24(22.0%)	14(12.8%)	109(100.0%)	**<0.001**
Yes	0(.0%)	5(45.5%)	6(54.5%)	11(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 7

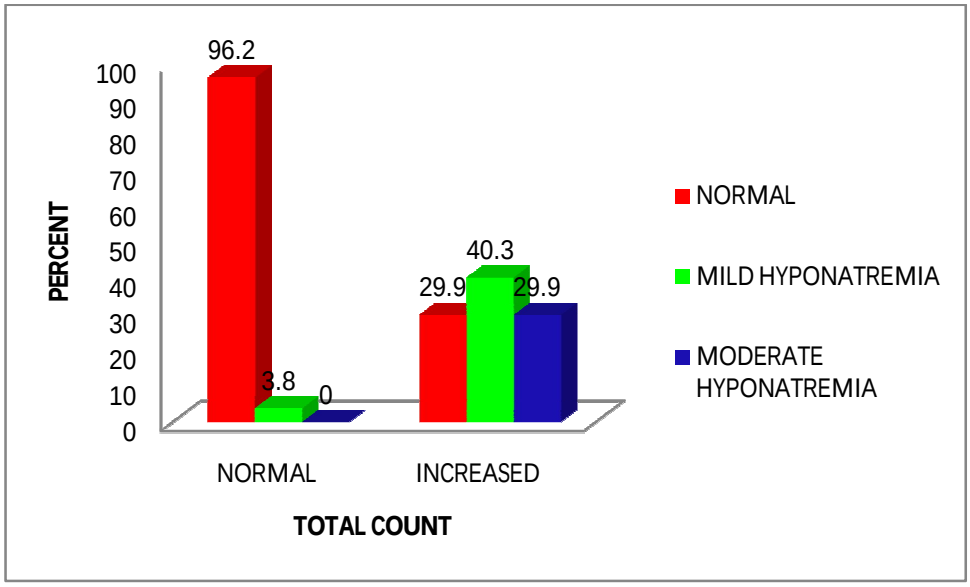


All children requiring mechanical ventilation had hyponatremia (p <0.001).

CROSSTABLE 8: COMPARISON OF TOTAL COUNT VERSUS SERUM SODIUM

Total count	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Normal	51(96.2%)	2(3.8%)	0(.0%)	53(100.0%)	**<0.001****
Increased	20(29.9%)	27(40.3%)	20(29.9%)	67(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 8

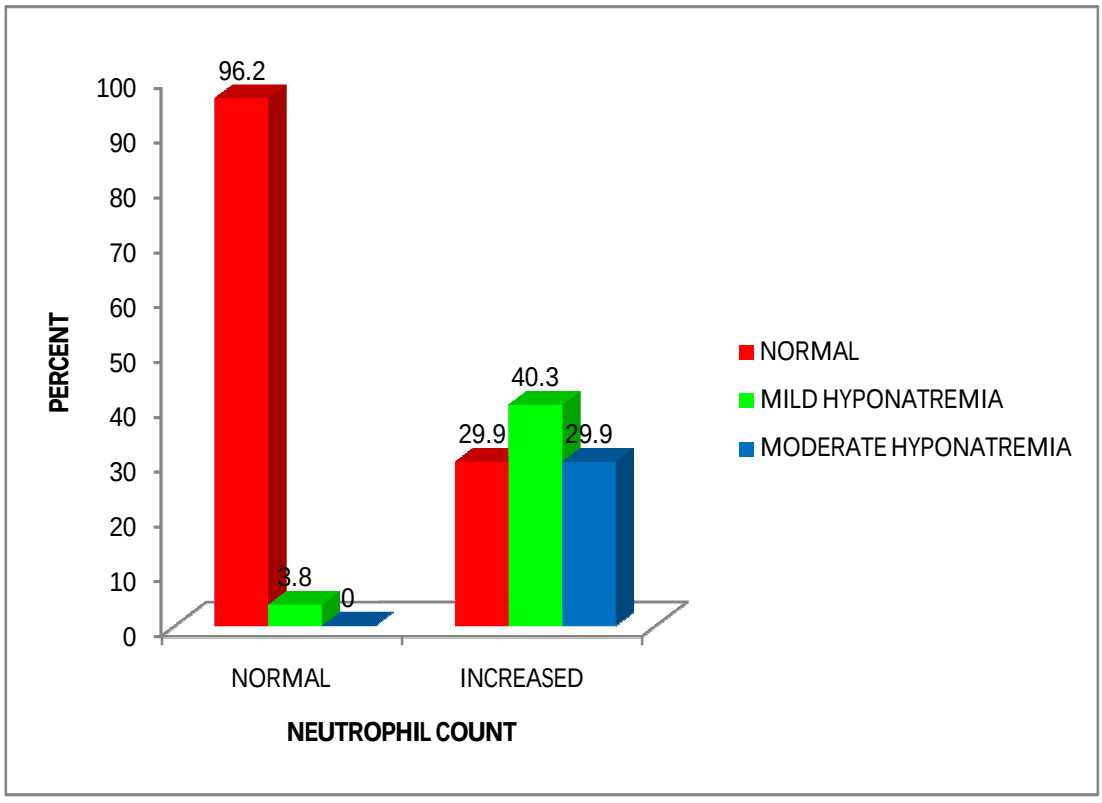


Hyponatremia was seen in children with high initial counts ($p < 0.001$)

CROSSTABLE 9- COMPARISON OF NEUTROPHIL COUNT VS SERUM SODIUM

Neutrophil count	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Normal	51(96.2%)	2(3.8%)	0(.0%)	53(100.0%)	**<0.001****
Increased	20(29.9%)	27(40.3%)	20(29.9%)	67(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 9

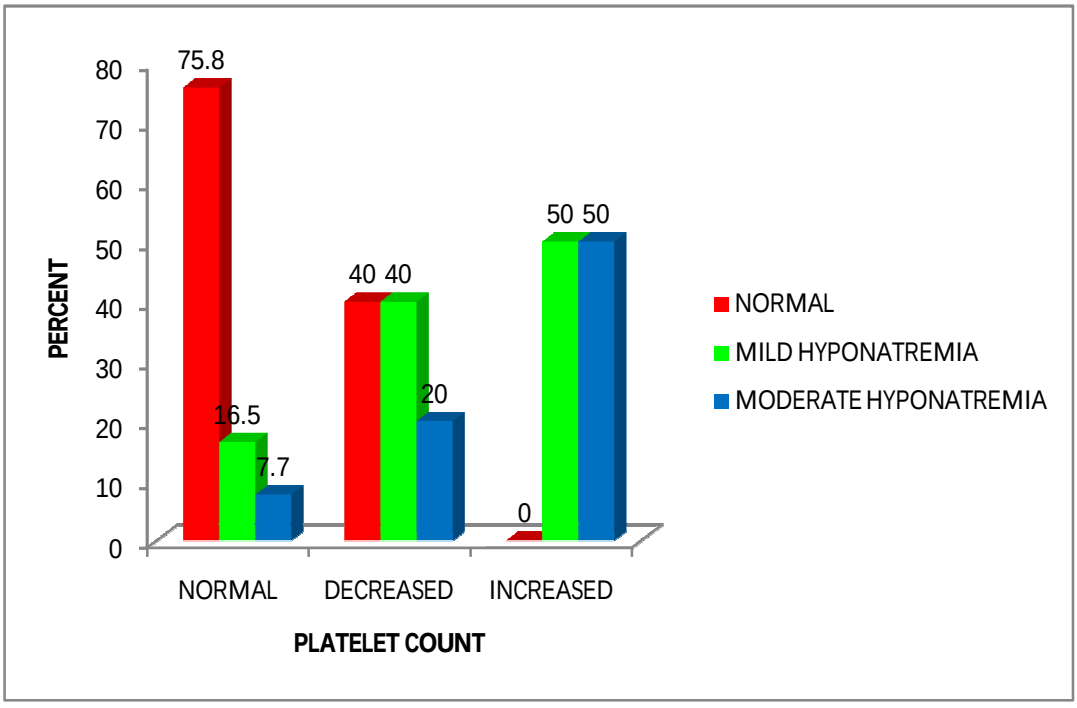


Hyponatremia was associated with high neutrophil counts ($p < 0.001$)

CROSSTABLE 10: COMPARISON OF PLATELET COUNTS VERSUS SERUM SODIUM

Platelet count	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Decreased	2(40.0%)	2(40.0%)	1(20.0%)	5(100.0%)	**<0.001****
Normal	69(75.8%)	15(16.5%)	7(7.7%)	91(100.0%)	
Increased	0(.0%)	12(50.0%)	12(50.0%)	24(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM – 10

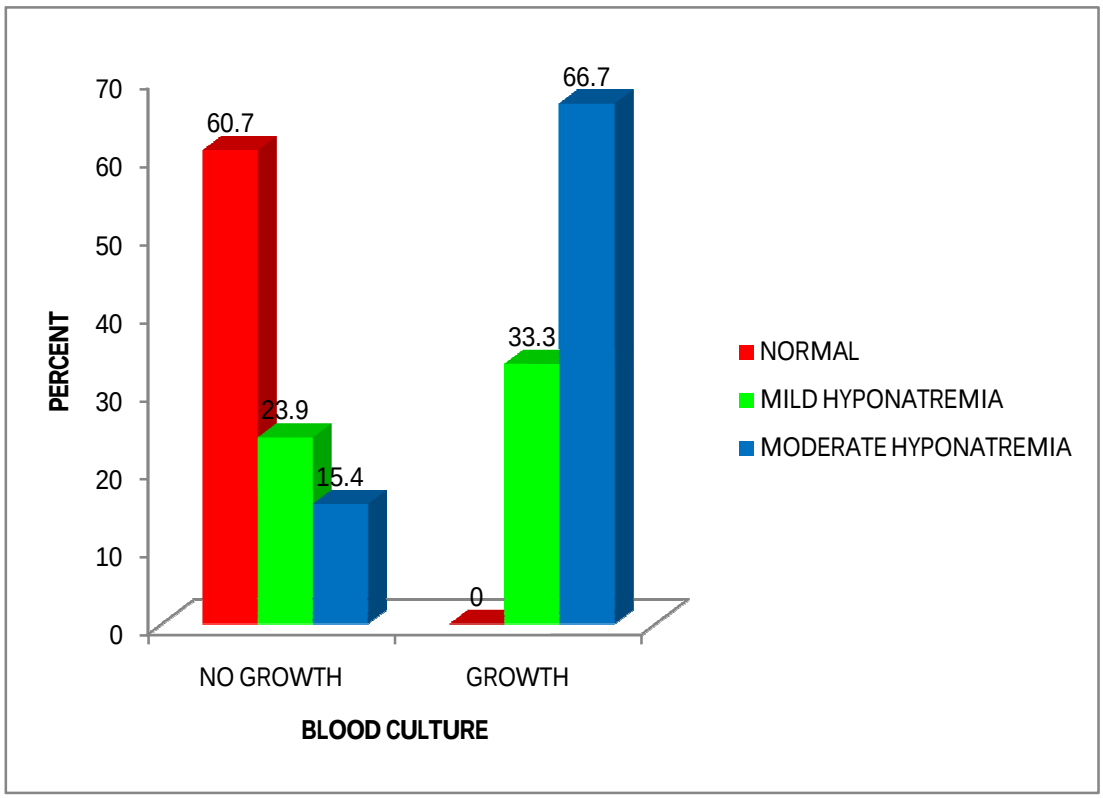


Hyponatremia was more associated with reactive thrombocytosis ($p < 0.001$)

TABLE 11- BLOOD CULTURE VS SERUM SODIUM

Blood culture	Serum Sodium			Total	P Value
	Normal	Mild	Moderate		
No growth	71(60.7%)	28(23.9%)	18(15.4%)	117(100.0%)	0.038
Growth	0(.0%)	1(33.3%)	2(66.7%)	3(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 11

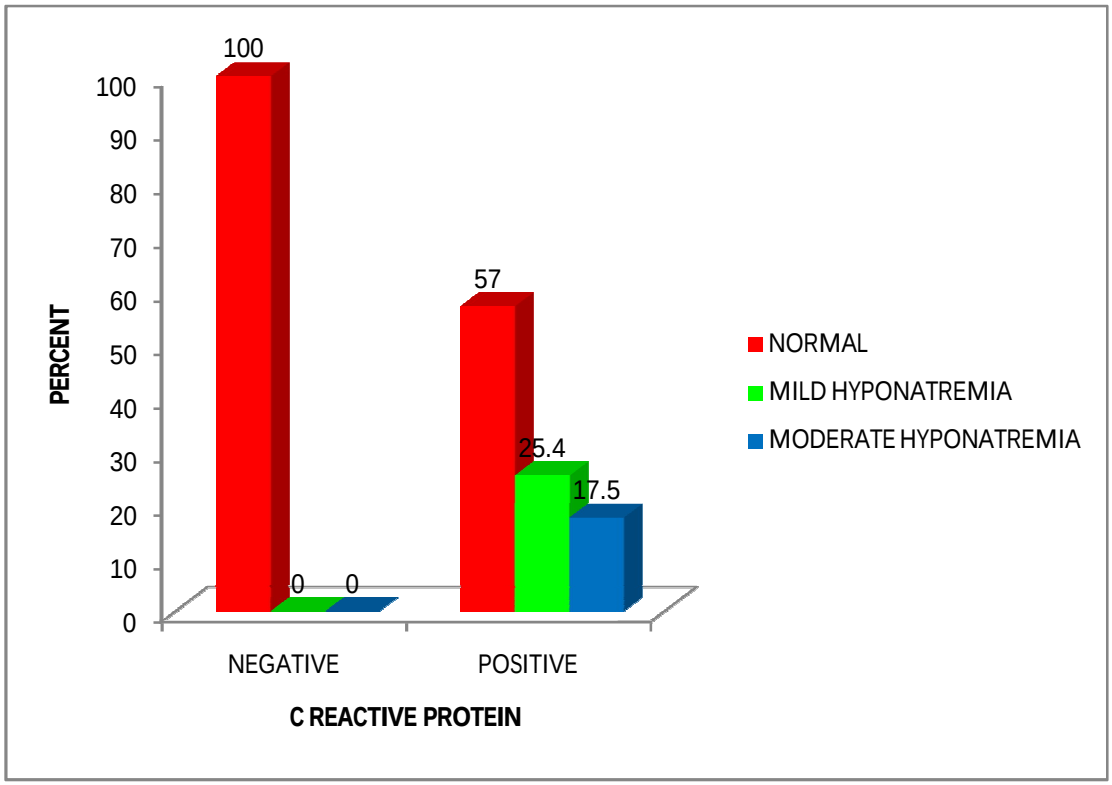


Only 3 children showed growth in culture and all of them had hyponatremia (p= 0.038)

CROSSTABLE 12– COMPARISON OF C-REACTIVE PROTEIN VERSUS SERUM SODIUM

CRP	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Negative	6(100.0%)	0(.0%)	0(.0%)	6(100.0%)	0.113
Positive	65(57.0%)	29(25.4%)	20(17.5%)	114(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 12

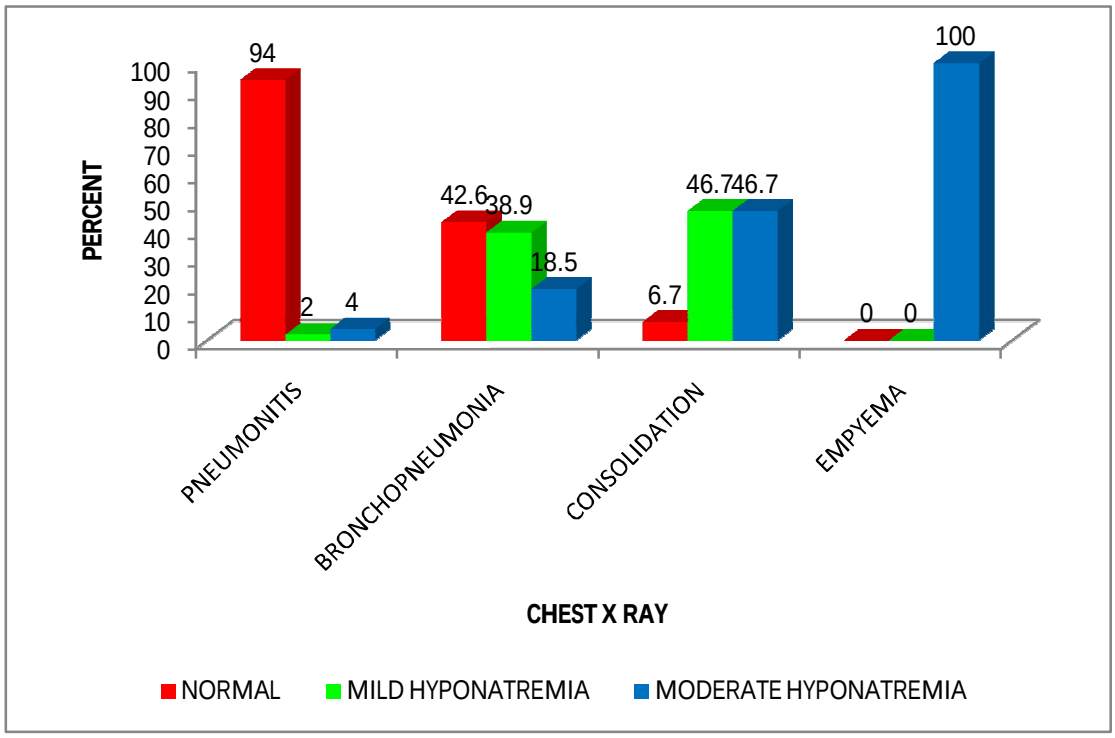


No relation was found between qualitative CRP and hyponatremia (p =0.113)

CROSSTABLE 13- COMPARISON OF CHEST X RAY VERSUS SERUM SODIUM

Chest X- Ray	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Pneumonitis	47(94.0%)	1(2.0%)	2(4.0%)	50(100.0%)	**<0.001****
Bronchopneumonia	23(42.6%)	21(38.9%)	10(18.5%)	54(100.0%)	
Consolidation	1(6.7%)	7(46.7%)	7(46.7%)	15(100.0%)	
Empyema	0(.0%)	0(.0%)	1(100.0%)	1(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 13

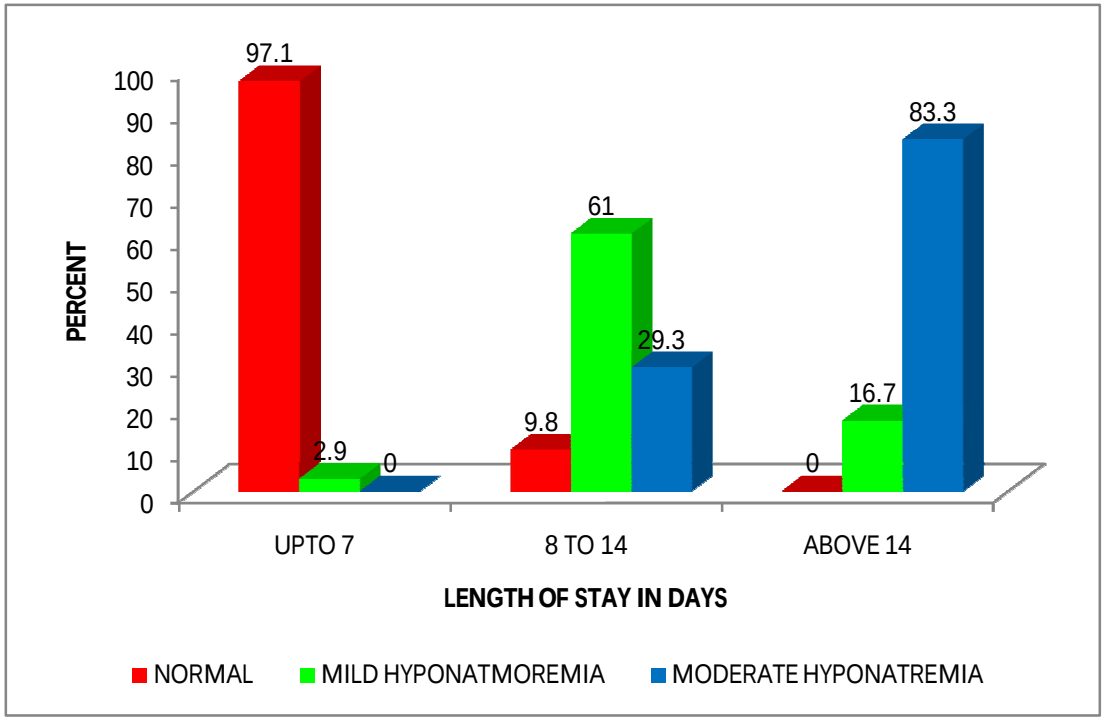


Hyponatremia was more commonly associated with consolidation (P< 0.001)

CROSSTABLE 14- COMPARISON OF LENGTH OF STAY VERSUS SERUM SODIUM

Length of stay in days	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Up to 7	67(97.1%)	2(2.9%)	0(.0%)	100.0%	**<0.001****
8 to 14	4(9.8%)	25(61.0%)	12(29.3%)	41(100.0%)	
Above 14	0(.0%)	1(16.7%)	5(83.3%)	6(100.0%)	
Total	71(61.2%)	28(24.1%)	17(14.7%)	116(100.0%)	

BAR DIAGRAM - 14

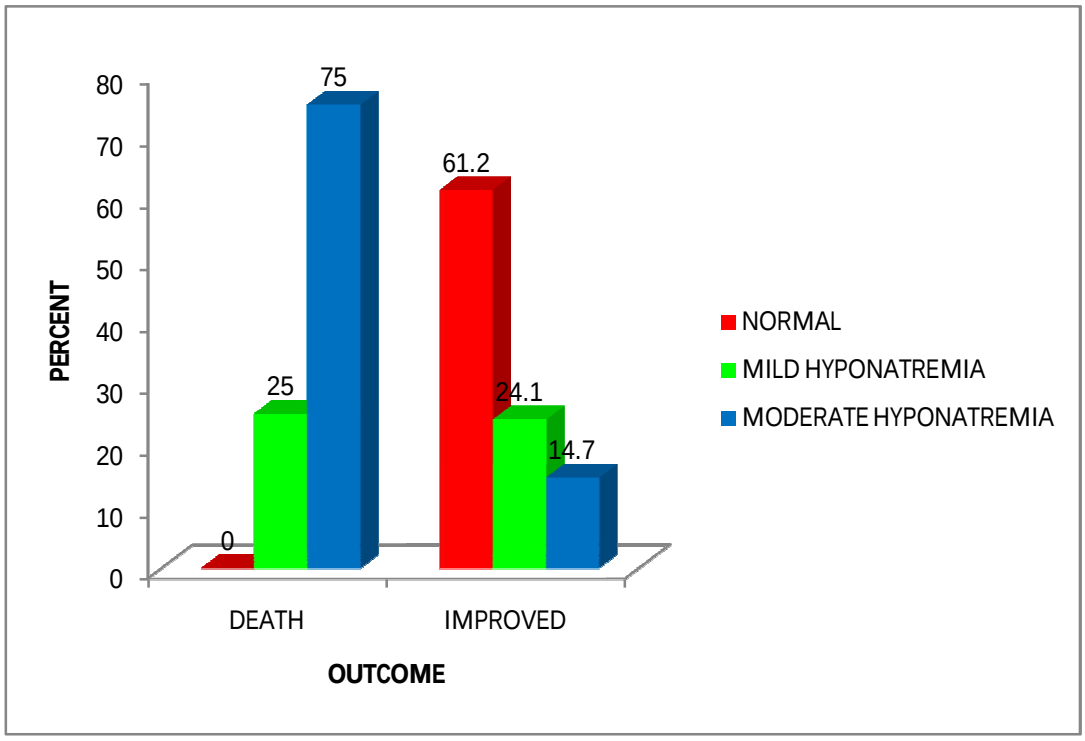


Hyponatremia was associated with increased length of hospital stay (p <0.001)

CROSSTABLE 15: COMPARISON OF OUTCOME VERSUS SERUM SODIUM

Outcome	Serum Sodium			Total	P value
	Normal	Mild	Moderate		
Death	0(.0%)	1(25.0%)	3(75.0%)	4(100.0%)	0.004
Improved	71(61.2%)	28(24.1%)	17(14.7%)	116(100.0%)	
Total	71(59.2%)	29(24.2%)	20(16.7%)	120(100.0%)	

BAR DIAGRAM - 15



Hyponatremia was associated with increased length of hospital stay (p =0.004)

RESULTS

This study was done to find out the incidence of hyponatremia in children hospitalised with community acquired pneumonia and to analyse if it could be used as a tool in predicting the severity of the disease.

A total of 120 hospitalised children were studied which included 67 (55.8%) boys and 53 (44.2%) girls. Among them 42.5% (51/120) belonged to less than 1 year of age and 57.5% (69/120) belonged to 1 to 5 years of age. Of the 120 children 40.8% (49/120) had hyponatremia at the time of admission. Mild hyponatremia was seen in 24.2% and moderate hyponatremia was seen in 16.7% of children. None of the cases had severe hyponatremia.

The incidence of hyponatremia was calculated from the total sample and the relationship of hyponatremia to different clinical parameters (like age, sex, BTS class, initial temperature, initial heart rate, shock, requirement of mechanical ventilation, length of hospital stay, outcome) and laboratory parameters (initial total count, neutrophil count, platelet count, blood culture, CRP , chest x ray) were analysed.

The parameters used to assess the severity of pneumonia were

1. Requirement of mechanical ventilation
2. Presence of shock
3. Length of hospital stay
4. Outcome

This study showed that 60.8% (31/51) of children under 1 year had hyponatremia which was considered statistically significant (p= 0.001) when compared to children between 1 to 5 years of age of whom 26% (18/69) were hyponatremic. There was no significant sex related difference in distribution of hyponatremia.

Hyponatremia was common in children who presented with severe pneumonia according to BTS classification ($p < 0.001$). Hyponatremia was a common occurence in children who had initial high temperature, tachycardia, leucocytosis, elevated neutrophils and reactive thrombocytosis. 27 children had shock on arrival (22.5%) out of which 92.6% (25/27) had hyponatremia which was considered statistically significant ($p < 0.001$). Among the children with shock 48.1% (13/27) had mild hyponatremia and 44.4%(12/27) had moderate hyponatremia. 11(9.2%) children required mechanical ventilation and all of them had hyponatremia which was mild in 45.5% (5/11) and moderate in 54.5(6/11) which is statistically significant ($p <0.001$).

Only 3(2.5%) children showed growth in blood culture. All the children with positive blood culture had hyponatremia (p= 0.038). No association was found between qualitative CRP and hyponatremia (p= 0.113).

Among the 45% (54/120) of children with bronchopneumonia 38.9% (21/54) had mild hyponatremia and 18.5% (10/54) had moderate hyponatremia. Consolidation was seen in 12.5% (15/ 120) of children.

Only 1(6.7%) child was found to be normonatremic in that group. 46.7% (7/15) had mild hyponatremia and 46.7% (7/15) had moderate hyponatremia. Out of the 120 children 50 (41.7%) children had pneumonitis. Among them only 3 (6%) had hyponatremia. Only 1 child had empyema and had moderate hyponatremia. From the above results consolidation was commonly associated with hyponatremia ($p < 0.001$).From the results it is evident that hyponatremia was associated with prolonged hospital stay($p < 0.001$).

Of the 120 children enrolled in the study 4 (3.3%) children expired and all of them were found to be hyponatremic [mild- 25%, moderate- 75% ;$p= 0.04$]. Estimated serum osmolality was found to be low in all patient with hyponatremia. The serum urea and creatinine levels were normal in all the patients. Urine spot sodium and urine osmolality was increased in 45(91.8%) patients with hyponatremia. Sodium values normalised by 4 days of hospitalisation in almost all children with hyponatremia.

DISCUSSION

The study sample was representative of children with CAP admitted in a tertiary care center in south India. The main result of the study described here was that hyponatremia was a common finding in children admitted with CAP. In this study 40.8% children had hyponatremia. However majority of the cases had only mild hyponatremia. The frequency (40.8%) of hyponatremia in this study is comparable with the results of previous studies by Massimiliano[40] et al (45.4%), Wrotek[42]et al (33.3%) and Sakellaropoulou[43] et al (35.2%). The fact that none of the cases had severe hyponatremia could be due to release of ANP in these children. ANP helps in maintaining water and electrolye balance through its diuretic and natriuretic effects as described by Haviv et al[49].

This study showed that hyponatremia was commonly associated with initial high temperature, tachycardia and elevation of non-specific inflammatory markers. All these results are in concordance with the results of the previous studies.

Hyponatremia was seen more in children with bronchopneumonia and consolidation. Only 1 child had empyema in this study and the child also had hyponatremia. The association of hyponatremia more with consolidation in this study also goes with the study by Glatstein et al[41].Hence this study showed that more severe the lung involvement more was the association with hyponatremia.

Most of the children with hyponatremia had low estimated serum osmolality, high urine sodium and high urine osmolality indicating that it is euvolemic hypotonic hyponatremia. By the conventional criteria all these patients may be labelled as having SIADH since most of the features fit into the criteria. Thus stress induced release of ADH causing salt loss and water retention might be reason for hyponatremia.But further studies are needed to unravel the cause of hyponatremia in acute infections.

Four children included in the study had expired.All the four children were found to be hyponatremic. This deserves a special mention but studies are to be done in large population to establish a significant association with mortality. All the children who required mechanical ventilation were found to be hyponatremic. Hence this study showed that hyponatremia was associated with poor outcome and increased morbidity of the disease like requirement of mechanical ventilation and prolonged hospital stay.

POSTIVE HIGHLIGHTS

- This study shows that hyponatremia is a common finding in children admitted with pneumonia.
- This study stresses the importance of measuring serum electrolytes in patients with pneumonia.
- This study also addresses the importance of appropriate fluid management in children.
- This study throws light on the fact that hyponatremia can predict the morbidity of the disease to a certain extent.

LIMITATIONS

- The study was done on a small sample of 120 children over a limited period of time.
- Studies in large population are to be done to draw conclusions in using hyponatremia as a valuable predictor in assessing the morbidity of pneumonia.
- The serological diagnosis to determine the aetiology of the organism causing pneumonia was not done in this study. If the serological diagnosis had been done then it would have thrown light on the organism causing more hyponatremia.
- Not all the investigations to prove SIADH was done in this study.

RECOMMENDATION

- Hyponatremia is a common finding in children with severe pneumonia and it can be useful in predicting the morbidity of children admitted with community acquired pneumonia.Hence serum electrolytes should be done in all children hospitalised with CAP.
- Most of the hyponatremia is dilutional and hence necessitates fluid restriction.

BIBLIOGRAPHY

1. Sandora T, Sectish T. Community acquired pneumonia. In: Kliegman RM, Stanton BF, Geme JWS, Schor NF, Behrman RE,editors. *Nelson textbook of paediatrics.* 19th ed. Philadelphia: Elsevier; 2011. p. 1474-1479.Vol(2).
2. Lussky HO, Friedstein H. Water retention in pneumonia. *Am J Dis Child*. 1920;19(5):337-343.
3. World Health Organization. Pneumonia. Fact sheet No. 331. 2014. Available at :http://www.who.int/mediacentre/factsheets/fs331/en/index. html. Accessed 27 September 2015.
4. World Health Organization. Children : reducing mortality. Fact sheet No. 178. 2014. Available at: http://www.who.int/mediacentre/factsheets/fs178 /en/index.html. Accessed 27 September 2015.
5. Hazinski TA. Typical and atypical pneumonias. In:Rudolph CD, Rudolph AM, Hostetter MK, Lister G, Siegel NJ, Apt L et al, editors. *Rudolphs paediatrics*. 21st ed. New York :McGraw Hill; 2003. P. 1980- 1983.
6. Stuckey-Schrock K, Hayes BL, George CM. Community-acquired pneumonia in children. *Am Fam Physician*. 2012 Oct 1;86(7):661-667.
7. Mandell LA, Wunderink R. Pneumonia. In Longo DL, Fauci AS, Kasper DL, Hauser SL, Jameson JL, Loscalzo J, editors. *Harrisons principles of internalmedicine*. 18th ed. New York: McGraw Hill;2012. p.2130-2132. Vol(2).
8. Byington CL, Bradley JS. Pediatric community acquired pneumonia. In: Cherry JD, Harrison GJD, Kaplan SL, Hotez P, Steinbach WJ, editors.

Feigin and cherry'stextbook of paediatric infectious diseases. 7th ed.Philadelphia: Elsevier; 2014.p. 283-294. Vol(1).

9. Light MJ. Pneumonia. In: Light MJ editor. Paediatric Pulmonology AAP. 1st ed. New Delhi: Jaypee Brothers; 2013. P. 391-421.
10. Durbin WJ, Stille C. Pneumonia. *Pediatr Rev*. 2008 May;29(5):147-158.
11. Tan TQ, Mason EO Jr, Wald ER, Barson WJ, Schutze GE, Bradley JS et al. Clinical characteristics of children with complicated pneumonia caused by streptococcus pneumoniae. *Pediatrics*. 2002 Jul;110(1.1):1-6.
12. Qiao Y, Ning X, Chen Q, Zhao R, Song W, Zheng Y et al. Clinical and molecular characteristics of invasive community acquired staphylococcus aureus infections in chinese children. *BMC Infect Dis*. 2014 Nov 7;14:582.
13. Parker D, Prince A. Immunopathogenesis of Staphylococcus aureus pulmonary infection. *SeminImmunopathol*. 2012 Mar;34(2):281-297.
14. Len KA, Bergert L, Patel S, Melish M, Kimata C, Erdem G. Community acquired Staphylococcus aureus pneumonia among hospitalized children in Hawaii. *PediatrPulmonol*. 2010 Sep;45(9):898-905.
15. PrincipiN,Esposito S. Mycoplasma pneumoniae and chlamydia pneumoniae cause lower respiratory tract disease in paediatric patients. *Current opinion in infectious diseases*.2002; 15(3): 295-300.
16. Waris ME, Toikka P, Saarinen T ,Nikkari S, Meurman O, Vainionpaa R et al. Diagnosis of Mycoplasma pneumoniae pneumonia in children. *J ClinMicrobiol*. 1998 Nov;36(11):3155-3159.

17. Hsieh SC,KuoYT,ChernMS,Chen CY, Chan WP,Yu C. Mycoplasma pneumonia clinical and radiographic features in 39 children. *Pediatrics International*.2007; 49: 363–367.
18. Atkinson TP,BalishMF,Waites KB. (2008). Epidemiology clinical manifestations pathogenesis and laboratory detection of mycoplasma pneumoniae infections. *FEMS microbiology reviews*.2008;32(6):956-973.
19. CillaG,OnateE,PerezYarzaEG,MontesM,VicenteD,PerezTrallero E. Viruses in community acquired pneumonia in children aged less than 3 years old: High rate of viral coinfection. *J. Med. Virol*.2008;80:1843-1849.
20. HenricksonKJ.Viral pneumonia in children.*Seminars inPediatric Infectious Diseases.*1998 Jul;9(3): 217-233.
21. Howard TS,HoffmanLH,StangPE,SimoesEA.Respiratory syncytial virus pneumonia in the hospital setting: length of stay, charges, and mortality.*J Pediatr*.2000 Aug;137(2):227-232.
22. Lahti E, Peltola V, Virkki R, Ruuskanen O. Influenza pneumonia. *PediatrInfect Dis J*. 2006 Feb;25(2):160-164.
23. Dawood FS, Fiore A, Kamimoto L, Nowell M, Reingold A, Gershman K et al.Influenza associated pneumonia in children hospitalized with laboratory confirmed influenza 2003-2008. *Pediatr Infect Dis J*. 2010 Jul;29(7):585-590.
24. Harari M, Shann F, Spooner V, Meisner S, Carney M, de Campo J. Clinical signs of pneumonia in children. *Lancet.* 1991 Oct 12;338(8772): 928-930.

25. Mahabee-Gittens EM, Grupp-Phelan J, Brody AS, Donnelly LF, Bracey SE, Duma EM et al. Identifying children with pneumonia in the emergency department. *ClinPediatr (Phila)*. 2005 Jun; 44(5):427-435.
26. Harris M, Clark J, Coote N, Fletcher P, Harnden A, McKean M, Thomson A. (2011). British Thoracic Society guidelines for the management of community acquired pneumonia in children update 2011. *Thorax*.2011; 66(2):ii1-ii23.
27. Buckingham SC, King MD,Miller ML. (2003).Incidence and etiologies of complicated parapneumonic effusions in children 1996 to 2001. Pediatr Infect Dis J.2003; 22(6):499-503.
28. Eastham KM, Freeman R, Kearns AM, Eltringham G, Clark J, Leeming J etal.Clinical features aetiology and outcome of empyema in children in the north east of England. *Thorax*. 2004 Jun;59(6):522-525.
29. Qin Q, Shen KL. Community-acquired Pneumonia and its Complications. *Indian J Pediatr*. 2015 Aug;82(8):745-751.
30. Adrogue HJ, Madias NE.Hyponatremia. *N Engl J Med*. 2000 May 25;342(21):1581-1589.
31. Trachtman H. Sodium and water homeostasis. *PediatrClin North Am*. 1995 Dec;42(6):1343-1363.
32. Dreyfuss D, Leviel F, Paillard M, CosteF.Resetting of the vasopressin osmostat during infectious pneumonia.*Am J Med*.1991 Mar;90(3):407-408.

33. Swart RM, Hoorn EJ, Betjes MG, Zietse R. Hyponatremia and inflammation: the emerging role of interleukin-6 in osmoregulation. *Nephron Physiol*. 2011;118(2):45-51.
34. Charles R, Rees JR. Inappropriate secretion of antidiuretic hormone in pneumonia. *Postgrad Med J*. 1975 Sep;51(599):663-664.
35. Dixon BS, Anderson RJ. Pneumonia and the syndrome of inappropriate antidiuretic hormone secretion dont pour water on the fire.*Am Rev RespirDis*.1988;138(3):512-513.
36. Ganong WF. *Review of medical physiology*. 22nd ed. Boston: McGraw Hill;2005.
37. Cooke CR, Turin MD, Walker WG. The syndrome of inappropriate antidiuretic hormone secretion (SIADH): pathophysiologic mechanisms in solute and volume regulation. *Medicine*.1979; 58(3):240-251.
38. Greenbaum LA. Electrolyte and acid base disorders. In: Kliegman RM, Stanton BF, Geme JWS, Schor NF, Behrman RE, editors. *Nelson textbook of paediatrics.* 19th ed. Philadelphia: Elsevier; 2011. p. 212-219. Vol (1).
39. Ellison DH, BerlT.The syndrome of inappropriate antidiuresis. *N Engl J Med*.2007; 356(20):2064-2072.
40. Don M, Valerio G, Korppi M, Canciani M. Hyponatremia in pediatric community-acquired pneumonia. *PediatrNephrol*. 2008 Dec;23(12):2247-2253.
41. Glatstein M, Rozen R, Scolnik D, Rimon A, Grisaru-Soen G, Freedman S et al. Radiologic predictors of hyponatremia in children hospitalized with

community acquired pneumonia. *PediatrEmerg Care*. 2012 Aug;28(8):764-766.

42. Wrotek A, Jackowska T. Hyponatremia in children hospitalized due to pneumonia. *AdvExp Med Biol*. 2013;788:103-108.
43. Sakellaropoulou A, Hatzistilianou M, Eboriadou M, Athanasiadou Piperopoulou F. Hyponatraemia in cases of children with pneumonia. *ArchMed Sci*. 2010 Aug 30;6(4):578-583.
44. Nair V, Niederman MS, Masani N, Fishbane S. Hyponatremia in community acquired pneumonia. *Am J Nephrol*. 2007;27(2):184-190.
45. Prasad SV, Singhi S, Chugh KS. Hyponatremia in sick children seeking pediatric emergency care. *Indian Pediatr*. 1994 Mar;31(3):287-294.
46. Singhi S. Hyponatremia in hospitalized critically ill children current concepts. *Indian J Pediatr*. 2004 Sep;71(9):803-807.
47. Kaneko K, Kaneko K. Hyponatremia in children with respiratory tract infection. *PediatrNephrol*. 2009 Aug;24(8):1595.
48. Shann F, Germer S. Hyponatraemia associated with pneumonia or bacterial meningitis. *Arch Dis Child*. 1985 Oct;60(10):963-966.
49. Haviv M, Haver E, Lichtstein D, Hurvitz H, Klar A. Atrial natriuretic peptide in children with pneumonia. *PediatrPulmonol*. 2005 Oct;40(4):306-309.

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.N.Thrilok
Postgraduate in M.D.(Paediatrics)
Madras Medical College
Chennai – 600 003.

Dear Dr. N.Thrilok,

The Institutional Ethics Committee has considered your request and approved your study titled **"Hyponatremia as a Predictor of Severity in Paediatric Community Acquired Pneumonia" No.57012015.**

The following members of Ethics Committee were present in the meeting held on 20.01.2015 conducted at Madras Medical College, Chennai-3.

1. Dr.C.Rajendran, M.D.,	: Chairperson
2. Dr.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3. Prof.B.Kalaiselvi, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4. Prof.R.Nandini, M.D., Inst.of Pharmacology, MMC	: Member
5. Prof.P.Ragumani, M.S., Professor, Inst.of Surgery, MMC	: Member
6. Prof.Md.Ali, M.D., D.M., Prof. & HOD of Medl.G.E., MMC	: Member
7. Prof.K.Ramadevi, Director , Inst.of Biochemistry, MMC	: Member
8. Prof.Saraswathy, M.D., Director, Pathology, MMC, Ch-3	: Member
9. Prof.S.G.Sivachidambaram, M.D., Director i/c, Inst.of Internal Medicine, MMC	: Member
10.Thiru S.Rameshkumar, Administrative Officer	: Lay Person
11.Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
12.Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee
MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

INFORMED CONSENT FORM

Study place: INSTITUTE OF CHILD HEALTH AND HOSPITAL FOR CHILDREN.

Title of the study:**Hyponatremia as a predictor of severity in paediatric community acquired pneumonia**

Name of the investigator:**Dr.N.THRILOK.**

Name of the Participant: Age: Sex:

Hospital number:

1. I have read and understood this consent form and the information provided to me regarding the participation in the study.

2. I have had the consent document explained to me.

3. I have been explained about the nature of the study.

4. I have been explained about my rights and responsibilities by the investigator.

5.I will allow my child to undergo blood tests and x-ray during the study whole heartedly.

6. I have informed the investigator of all the treatments I am taking or have taken in the past including any native (alternative) treatment.

7. I have been advised about the risks associated with my participation in this study.*

8. I agree to cooperate with the investigator and I will inform him/her immediately if I suffer unusual symptoms. *

9. I have not participated in any research study in the past.

10. I am aware of the fact that I can opt out of the study at any time without having to give any reason and this will not affect my future treatment in this hospital. *

11. I am also aware that the investigator may terminate my participation in the study at any time, for any reason, without my consent. *

12. I hereby give permission to the investigators to release the information obtained from me as result

of participation in this study to the sponsors, regulatory authorities, Govt. agencies, and IEC. I understand that they are publicly presented.

13. I have understood that my identity will be kept confidential if my data are publicly presented

14. I have had my questions answered to my satisfaction.

15. I have decided to be in the research study.

I am aware that if I have any question during this study, I should contact the investigator. By signing this consent form I attest that the information given in this document has been clearly explained to me and understood by me, I will be given a copy of this consent document.

Name and signature / thumb impression of the parents/guardian

Name _____ Signature_____ Date_____

Name and Signature of impartial witness:

Name _____ Signature_____ Date_____

Name and Signature of the investigator or his representative obtaining consent:

Name _____ Signature_____ Date_____

INFORMATION SHEET

Place of study: INSTITUTE OF CHILD HEALTH AND HOSPITAL FOR CHILDREN.
Name of Investigator: **Dr.N.THRILOK**

Name of Participant Age: Sex:

Hospital No:

Study title:Hyponatremia as a predictor of severity in paediatric community acquired pneumonia

• We are conducting a study on**Hyponatremia as a predictor of severity in paediatric community acquired pneumonia**

We request you to participate in the study

•To find out the incidence of hyponatremia in pneumonia and to findout whether it can be used as a predictor of severity in children hospitalised with community acquired pneumonia between ages of 2 months and 5 years

• Detailed clinical examination will be done. Routine blood investigations will be taken along with chest xray at the time of admission. Repeat blood investigation and urine samples will be collected from certain patients.

• The privacy of the patients in the research will be maintained throughout the study. Inthe event of any publication or presentation resulting from the research, no personallyidentifiable information will be shared.
• Taking part in this study is voluntary. You are free to decide whether to participate inthis study or to withdraw at any time; your decision will not result in any loss ofbenefits to which you are otherwise entitled.
• The results of the special study may be intimated to you at the end of the study periodor during the study if anything is found abnormal which may aid in the managementor treatment.

Signature of investigator, Signature of parent/guardian
Date:

சுயஒப்புதல் படிவம்

ஆய்வு தலைப்பு : குழந்தைகளில் வரும் நிமோனியா (Pneumonia) நோயின் தீவிரத்தை குறைந்த இரத்த சோடியம் (Sodium) அளவு எப்படி கணிக்கிறது.

இடம் : அரசு குழந்தை நல மருத்துவமனை, எழும்பூர், சென்னை-8.

ஆய்வாளரின் பெயர் : மருத்துவர் ந.திர்லோக்

குழந்தையின் பெயர் :

வயது: தேதி:

பாலினம் : உள் நோயாளி எண் :

..... என்பவராகிய நான் இந்த ஆய்வின் விவரங்களைபடித்து தெரிந்து கொண்டேன் (அல்லது) எனக்கு படித்து காண்பிக்கப்பட்டது. அதன் நோக்கங்களும் முறையாக அறிந்து கொண்டேன். எனது சந்தேகங்கள் அனைத்திற்கும் தகுந்த விளக்கம் அளிக்கப்பட்டது. இந்த ஆய்வில் முழு சுதந்திரத்துடன் மற்றும் சுயநினைவுடன் பங்கு கொள்ள சம்மதிக்கிறேன்.

1. இந்த ஒப்புதல் படிவத்தை நான் படித்து புரிந்து கொண்டேன்.
2. இச்சுய ஒப்புதல் படிவத்தை பற்றி எனக்கு விளக்கப்பட்டது.
3. இந்த ஆய்வினை பற்றிய அனைத்து தகவல்களும் எனக்கு தெரிவிக்கப்பட்டது.
4. இந்த ஆய்வில் எனது உரிமை மற்றும் பங்கினை பற்றி அறிந்து கொண்டேன்.
5. எனது குழந்தைக்கு இரத்த பரிசோதனை மற்றும் X-Ray எடுக்க முழுமனதுடன் சம்மதிக்கிறேன்.
6. தற்போது என் குழந்தை எடுத்துக் கொண்டிருக்கும் (அல்லது) முன்பு எடுத்துக் கொண்ட மருத்துவ விவரங்களை ஆய்வாளருக்கு தெரிவித்துள்ளேன்.
7. இந்த ஆய்வின் என் குழந்தையின் பங்களிப்பினால் குழந்தைக்கு ஏந்த பின் விளைவுகளும் ஏற்படாது.
8. நான் ஆய்வாளருக்கு முழு ஒத்துழைப்பு கொடுப்பேன் மற்றும் உடலில் ஏதேனும் புதிய பிரச்சினை ஏற்பட்டால் உடனே தெரிவிப்பேன்.
9. நான் இதற்கு முன் ஏந்த ஆய்விலும் பங்கேற்றது இல்லை.
10. இந்த ஆராய்ச்சியில் இருந்து நான் எந்நேரமும் பின் வாங்கலாம் என்பதையும் அதனால் எந்த பாதிப்பும் ஏற்படாது என்பதையும் நான் புரிந்து கெர்ணடேன்.

11. ஆய்வாளர் இந்த ஆய்வில் என் குழந்தையின் பங்களிப்பை எந்த நேரத்திலும் எந்த காரணத்திற்காகவும், எந்தவித ஒப்புதல் இல்லாமலும் நிறுத்திக் கொள்ளலாம் எனவும் தெரிந்து கொண்டேன்.
12. இந்த ஆய்வில் கலந்து கொள்வதன் மூலம் என் குழந்தையிடம் பெறப்படும் தகவலை ஆய்வாளர் இன்ஸ்டிட்யூசனல் எத்திக்ஸ் கமிட்டியினரிடமோ, அரசு நிறுவனத்திடமோ தேவைப்பட்டால் பகிர்ந்து கொள்ளலாம் என சம்மதிக்கிறேன்.
13. இந்த ஆய்வின் முடிவுகளை வெளியிடும்போது என் குழந்தையின் பெயரோ, அடையாளமோ வெளியிடப்படாது என அறிந்து கொண்டேன். இந்த ஆய்வின் விவரங்களைக் கொண்ட தகவல் தாளை பெற்றுக் கொண்டேன்.
14. எனது எல்லா கேள்விகளுக்கும் திருப்பதிகரமாக பதிலளிக்கப்பட்டது.
15. இந்த ஆராய்ச்சியில் பங்களிக்க வேண்டுமென முடிவு செய்துள்ளேன்.

இந்த ஆய்வில் பங்கேற்கும் பொழுது ஏதேனும் சந்தேகம் ஏற்பட்டால், உடனே ஆய்வாளரை தொடர்பு கொள்ள வேண்டும் என அறிந்து கொண்டேன்.

இச்சுய ஒப்புதல் படிவத்தில் கையெழுத்திடுவதன் மூலம் இதிலுள்ள அனைத்து விஷயங்களும் எனக்கு தெளிவாக விளக்கப்பட்டது என்று தெரிவிக்கிறேன். இச்சுய ஒப்புதல் படிவத்தின் ஒரு நகல் எனக்கு கொடுக்கப்படும் என்று தெரிந்து கொண்டேன்.

பங்கேற்பாளர்

பங்கேற்பாளருடைய பெயர் மற்றும் கையொப்பம்/கைரேகை (அல்லது சட்ட ரீதியான பிரதிநிதி - பங்கேற்பாளர் செயல்திறமையற்றவராக இருந்தால் / 17 வயதிற்கு கீழ் உள்ளவர்களுக்கு - பெற்றோர் / பாதுகாவலர்)

....

பெயர் கையொப்பம் / கைரேகை தேதி

நடுநிலையிலுள்ள சாட்சியாளரின் பெயர் மற்றும் கையொப்பம் (படிப்பறிவு இல்லாத மக்களுக்கு)

....

பெயர் கையொப்பம் / கைரேகை தேதி

நடுநிலமையிலுள்ள சாட்சியாளரின் முகவரி மற்றும் தொலைபேசி எண்

....

ஆராய்ச்சியாளரின் பெயர் கையொப்பம் தேதி

தகவல் படிவம்

ஆய்வு தலைப்பு : குழந்தைகளில் வரும் நிமோனியா (Pneumonia) நோயின் தீவிரத்தை குறைந்த இரத்த சோடியம் (Sodium) அளவு எப்படி கணிக்கிறது.

இடம் : அரசு குழந்தை நல மருத்துவமனை, எழும்பூர், சென்னை-8.

ஆய்வாளரின் பெயர் : மருத்துவர் ந.திர்லோக்

குழந்தையின் பெயர் :

வயது: தேதி:

பாலினம் : உள் நோயாளி எண் :

தங்கள் குழந்தையும் இந்த ஆய்வில் பங்கு பெற கேட்டுக் கொள்கிறோம்.

1. குழந்தைகளில் வரும் நிமோனியா (Pneumonia) நோயில் இரத்த சோடியம் (Sodium) அளவு எவ்வளவு குறைந்துள்ளது மற்றும் அது நோயின் தீவிரத்தைக் கணிக்க உதவுகின்றதா என்பதே இந்த ஆய்வின் நோக்கம் ஆகும்.
2. குழந்தைக்கு முழு உடல் பரிசோதனை செய்யப்படும். அதன் பின் இரத்தப் பரிசோதனைகள் மற்றும் X-Ray எடுக்கப்படும். தேவையான குழந்தைகளுக்கு மீண்டும் இரத்தப் பரிசோதனை மற்றும் சிறுநீர் பரிசோதனை எடுக்கப்படும்.
3. இந்த ஆய்வின் முடிவுகள் பற்றி உங்களுக்கு தெரிவிக்கப்படும்.
4. இந்த ஆய்வின் மூலம் கண்டறியப்படும் முடிவுகள் உங்கள் குழந்தையின் சிகிச்சைக்கு மிகவும் உதவியாக இருக்கும்.
5. இந்த ஆய்வில் கலந்து கொள்வதன் மூலம் என் குழந்தையிடம் பெறப்படும் தகவலை ஆய்வாளர் இன்ஸ்டிட்யூசனல் எத்திக்ஸ் கமிட்டியினரிடமோ, அரசு நிறுவனத்திடமோ தேவைப்பட்டால் பகிர்ந்து கொள்ளலாம் என சம்மதிக்கிறேன்.
6. உங்கள் குழந்தையை பற்றிய விபரங்கள் யாருக்கும் தெரிவிக்காமல் பாதுகாக்கப்படும்.

7. இந்த ஆய்வில் பங்கு பெறுவது உங்கள் தனிப்பட்ட விருப்பம் ஆகும். நீங்கள் இந்த ஆய்விலிருந்து எப்பொழுது வேண்டுமானாலும் விலகிக் கொள்ளலாம். அவ்வாறு விலகுவதால் குழந்தையின் சிகிச்சையில் எவ்வித பாதிப்பும் ஏற்படாது.
8. ஆய்வாளர் இந்த ஆய்வில் என் குழந்தையின் பங்களிப்பை எந்த நேரத்திலும் எந்த காரணத்திற்காகவும், எவ்வித ஒப்புதல் இல்லாமலும் நிறுத்திக் கொள்ளலாம் எனவும் தெரிந்து கொண்டேன்.
9. ஆய்வில் பங்கு கொள்ளும்போது ஏதேனும் சந்தேகம் ஏற்பட்டால் ஆய்வாளரை தொடர்பு கொள்ளலாம்.

இச்சுய தகவல் படிவத்தில் கையெழுத்திடுவதன் மூலம் இதிலுள்ள அனைத்து விஷயங்களும் எனக்கு தெளிவாக விளக்கப்பட்டது என்று தெரிவிக்கிறேன். இச்சுய படிவத்தின் ஒரு நகல் எனக்கு கொடுக்கப்படும் என்று தெரிந்துகொண்டேன்.

பங்கேற்பாளர்

பங்கேற்பாளருடைய பெயர் மற்றும் கையொப்பம்/கைரேகை (அல்லது சட்ட ரீதியான பிரதிநிதி - பங்கேற்பாளர் செயல்திறமையற்றவராக இருந்தால் / 17 வயதிற்கு கீழ் உள்ளவர்களுக்கு - பெற்றோர் / பாதுகாவலர்)

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பெயர் கையொப்பம் / கைரேகை தேதி

நடுநிலையிலுள்ள சாட்சியாளரின் பெயர் மற்றும் கையொப்பம் (படிப்பறிவு இல்லாத மக்களுக்கு)

....

பெயர் கையொப்பம் / கைரேகை தேதி

நடுநிலமையிலுள்ள சாட்சியாளரின் முகவரி மற்றும் தொலைபேசி எண்

....

ஆராய்ச்சியாளரின் பெயர் கையொப்பம் தேதி

PROFORMA

NAME: AGE: SEX: IP NO:

DATE OF ADMISSION: DATE OF DISCHARGE:

HEIGHT: WEIGHT: LENGTH OF STAY :

CLINICAL FEATURES:

SYMPTOMS	DURATION
FEVER	
COUGH AND COLD	
BREATHLESSNESS	
LETHARGY	
REFUSAL OF FEEDS	
OTHER SYMPTOMS	

CLINICAL EXAMINATION:

INITIAL TEMPERATURE	
INITIAL HEART RATE	
RESPIRATORY RATE	
GRUNT	
RETRACTION	
OXYGEN SATURATION	
PERIPHERAL PULSES	
CAPILLARY REFILL TIME	

BTS CLASS – MILD TO MODERATE / SEVERE

INVESTIGATIONS:

INVESTIGATIONS	**DAY 1**	**DAY 4**
TOTAL COUNT		NA
DIFFERENTIAL COUNT		
PLATELET COUNT		
RANDOM BLOOD SUGAR		
BLOOD UREA		
SERUM CREATININE		
SODIUM		
POTASSIUM		NA
ESTIMATED SERUM OSMOLAITY		
CRP		

BLOOD CULTURE		
URINE SPOT SODIUM		NA
URINE OSMOLALITY		
CHEST X RAY		

REQUIREMENT OF MECHANICAL VENTILATION: YES/ NO

OUTCOME : IMPROVED / DEATH

MASTER CHART

SL.NO.	NAME	IP NO.	AGE	SEX	BTS CLASS	TEMP	HR	SHOCK	MECH VENT	TC	NEU%	PLATELET	NEC	CRP	SER SODIUM	CXR	SER OSMOLALITY	RPT SERUM SODIUM	URINE SPOT SODIUM	URINE OSMOLALITY	STAY	OUTCOME
1	VENKATESH	870131	2	1	1	1	1	0	0	2	2	1	0	1	0	1	1		-	-	0	1
2	LAVANYA	871945	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
3	PRAKASH	867018	1	1	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
4	NARMADA	858069	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
5	KRIBASRI	858870	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				1	1
6	SABITHA	858859	2	2	1	1	2	0	0	2	2	1	0	1	0	1	1				0	1
7	JAISHNAVI	857197	1	2	2	2	2	1	0	2	2	2	0	1	1	3	0	1	2	2	1	1
8	YOGESWARAN	858857	2	1	1	1	1	0	0	2	2	1	0	1	0	2	1				1	1
9	JAIKRISHNA	858841	1	1	2	2	2	1	0	2	2	2	0	1	2	2	0	1	2	2	1	1
10	KATHIRESAN	858856	2	1	1	1	2	0	0	1	1	1	0	1	0	1	1				0	1
11	KAVYAKALKI	858848	1	2	1	2	2	0	0	2	2	1	0	1	0	2	1				0	1
12	PUGALARASAN	867616	2	1	2	2	2	1	0	2	2	2	0	1	2	1	0	1	2	2	1	1
13	PRIYA	860426	2	2	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
14	HARISUDAN	860428	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
15	IMAN	859643	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
16	SAKTHISARAN	859662	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
17	VIDYASRI	859680	2	2	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
18	PADMAVATHI	862268	2	2	2	2	2	1	0	2	2	2	0	1	1	2	0	1	2	2	1	1
19	MAGILESH	859634	2	1	1	1	2	0	0	2	2	1	0	1	0	1	1				0	1
20	DHANYASRI	867576	1	2	1	1	2	0	0	2	2	1	0	1	0	1	1				0	1
21	ABISHEK	866846	1	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
22	MONISHKUMAR	867626	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
23	SARAVANAN	869820	2	1	2	2	2	0	0	2	2	0	0	1	1	3	0	1	2	2	1	1
24	HARISH	867741	1	1	1	1	1	0	0	2	2	1	0	1	0	2	1				0	1
25	KAVIARASAN	874002	2	1	2	2	2	0	0	2	2	2	0	1	1	2	0	1	2	2	1	1
26	SAILESH	867583	2	1	1	1	1	0	0	1	1	2	0	1	1	1	0	1	1	1	1	1
27	DHANUSRI	868888	2	2	1	2	2	0	0	1	1	0	0	1	0	1	1				0	1
28	TOUSIKA	869015	1	2	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
29	SANJANA	860998	2	2	1	2	2	0	0	1	1	1	0	1	0	2	1				0	1
30	SASHIKA	868529	1	2	1	2	2	0	0	2	2	2	0	1	2	3	0	1	2	2	1	1
31	TRISHANTH	870251	2	1	1	1	1	0	0	1	1	1	0	1	0	3	1				0	1
32	PRIYADARSHINI	870351	1	2	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
33	YASHVANTH	871742	1	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
34	LOKITHA	870513	2	2	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
35	B/O VADABI	869544	1	1	2	2	2	1	0	1	1	0	0	1	0	2	1				1	1
36	KANISRI	868658	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
37	MANIKANDAN	868245	1	1	1	1	1	0	0	2	2	2	0	1	1	3	0	1	2	2	1	1
38	HEMANTHKUMAR	868441	1	1	1	1	1	0	0	1	1	1	0	0	0	2	1				0	1
39	THANISH	858037	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
40	B/O DIVYA	861040	1	2	2	2	2	0	0	2	2	2	0	1	2	3	0	1	2	2	1	1
41	LOKESHWARI	857205	1	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
42	JEEVITHA	870243	2	2	1	1	1	0	0	2	2	0	0	1	1	3	0	1	1	1	0	1
43	MAHI	857218	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
44	DARWIN SANKAR	857207	2	1	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
45	KIRANKUMAR	857220	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
46	RATCHITHA	857214	2	2	1	2	2	1	0	2	2	1	0	1	0	2	1				0	1
47	PRANITHVEL	871928	1	1	2	2	2	1	0	2	2	2	0	1	1	2	0	1	2	2	1	1
48	KARTHIGA	868496	1	2	1	1	2	0	0	2	2	1	0	1	2	3	0	1	2	2	1	1
49	SAVITHA	857196	1	2	2	2	2	0	0	2	2	1	0	1	0	2	1				0	1
50	LAKSHANA	866358	1	2	2	2	2	1	0	2	2	2	0	1	2	2	0	1	2	2	1	1
51	KEERTHIKA	863552	1	2	1	2	2	0	0	1	1	1	0	1	0	1	1				0	1
52	YASINI	867512	2	2	1	1	2	0	0	2	2	2	0	1	2	3	0	1	2	2	1	1
53	POOJA	869895	1	2	2	2	2	1	0	2	2	2	1	1	2	3	0	1	2	2	2	1
54	KEERTHIGA	871841	1	2	2	2	2	1	1	2	2	1	0	1	2	2	0	1	2	2	2	1
55	MURUGESAN	862961	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
56	GOBESH	871068	2	1	2	2	2	1	1	2	2	1	0	1	1	2	0	1	2	2	1	1
57	KARTHI	870156	2	1	1	1	1	0	0	2	2	1	0	1	1	2	0	1	1	1	0	1
58	MADHUSRI	871230	2	2	2	2	2	1	0	2	2	1	1	1	1	2	0	1	2	2	2	1
59	PRADEEP	869900	1	1	2	2	2	1	0	2	2	1	0	1	1	2	0	1	2	2	1	1

MASTER CHART

60	ELAYAKUMAR	869137	1	1	2	2	2	0	0	2	2	2	0	1	1	2	0	1	2	2	1	1
61	VENKATESH	859678	1	1	2	2	2	1	1	2	2	1	0	1	2	2	0	1	2	2		0
62	VISWA	874056	1	1	2	2	2	1	0	2	2	2	0	1	1	2	0	1	2	2	1	1
63	DEEPIKA	869088	2	2	2	2	2	1	0	2	2	2	0	1	2	4	0	1	2	2	2	1
64	IRFAN	860443	1	1	2	2	2	1	0	2	2	2	0	1	1	2	0	1	2	2	1	1
65	JEYAPRAKASH	862300	2	1	1	1	2	0	0	2	2	1	0	1	0	1	1				0	1
66	KAMALESH	862272	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
67	LAKSHAN	871862	2	1	2	2	2	1	1	2	2	2	0	1	2	1	0	1	2	2	2	1
68	JAIAKASH	861695	2	1	2	2	2	0	0	2	2	1	0	1	2	2	0	1	2	2	1	1
69	MONICA	857198	1	2	2	2	2	0	0	2	2	1	0	1	2	3	0	1	2	2	1	1
70	RAKSHAYA	866944	1	2	2	2	2	0	1	2	2	0	1	1	2	2	0	1	2	2	2	1
71	TAMILSELVI	861680	1	2	1	1	1	0	0	1	1	1	0	0	0	1	1				0	1
72	JAINA	876431	2	2	2	2	2	1	0	2	2	2	0	1	1	2	0	1	2	2	1	1
73	JENIFER	857211	1	2	2	2	2	1	0	2	2	2	0	1	2	3	0	1	2	2	1	1
74	VARSHIKA	852056	1	2	2	2	2	1	0	2	2	2	0	1	2	2	0	1	2	2	1	1
75	ROHITH	876426	2	1	2	2	2	1	1	2	2	2	0	1	2	2	0		2	2		0
76	ANUCHITRA	872586	1	2	1	1	1	0	0	1	1	1	0	0	0	1	1				0	1
77	PRADIPA	876390	1	2	2	2	2	0	0	2	2	1	0	1	1	2	0	1	2	2	1	1
78	NARENDREN	858835	1	1	2	2	2	1	1	2	2	1	0	1	2	2	0	1	2	2		0
79	SADHANA	877213	2	2	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
80	DHANASHREE	877132	1	2	2	2	2	0	0	2	2	1	0	1	1	3	0	1	1	1	1	1
81	MITHUN	877199	1	1	2	2	2	0	0	2	2	1	0	1	1	2	0	1	2	2	1	1
82	POORNIMA	876398	1	2	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
83	KANISHKUMAR	860430	1	1	2	2	2	1	1	2	2	1	0	1	1	2	0		2	2		0
84	SUDHASHINI	876394	1	2	1	1	1	0	0	2	2	1	0	1	0	2	1				0	1
85	MAHESHWARAN	876381	2	1	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
86	MADESH	876378	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
87	MOHAMMED AJISH	877229	1	1	2	2	2	0	0	2	2	1	0	1	1	2	0	1	2	2	1	1
88	KAVIYA	859271	2	2	1	1	1	0	0	1	1	1	0	0	0	1					0	1
89	RISHI	875625	1	1	2	2	2	0	0	2	2	1	0	1	1	2	0	1	2	2	1	1
90	SUDARSHAN	875614	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
91	YUVARAJ	875683	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
92	GURUPRASAD	874788	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
93	ISAIPRIYAN	873331	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
94	AASHIK	873337	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
95	RAENESH	872642	1	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
96	VIGNESH	872601	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
97	LAVANYA	871945	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
98	KAVIYA	871924	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
99	LOHITH	971268	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
100	HAKKEEM	870610	2	1	1	1	1	0	0	1	1	1	0	1	1	2	0	1	2	2	1	1
101	ROHITH	862201	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
102	GOPIKA	867409	2	2	2	2	2	0	0	2	2	1	0	1	2	2	0	1	2	2	1	1
103	INDUMATHY	860824	2	2	2	2	2	1	1	2	2	1	0	1	1	3	0	1	2	2	1	1
104	RAVI	861152	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
105	SRIDHAR	862618	2	1	1	1	1	0	0	1	1	1	0	0	0	1	1				0	1
106	VAISHNAVI	868841	1	2	2	2	2	1	1	2	2	1	0	1	1	2	0	1	2	2	1	1
107	BRINDA	862211	2	1	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
108	SHYAM	858320	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
109	JOHN	859270	1	1	2	2	2	1	1	2	2	1	0	1	1	3	0	1	2	2	1	1
110	LILLY	858372	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
111	BALAJI	861050	1	1	2	2	2	0	0	2	2	1	0	0	0	2	1				1	1
112	SANKAR	862120	2	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
113	HARSHIKA	864519	1	2	2	2	2	0	0	2	2	2	0	1	1	2	0	1	2	2	1	1
114	SIVA	858472	2	1	1	1	1	0	0	2	2	1	0	1	0	1	1				0	1
115	SWATHI	867210	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
116	NAVEEN	862717	2	1	1	1	1	0	0	1	1	1	0	1	0	2	1				0	1
117	JEEVA	862200	1	1	2	2	2	0	0	2	2	2	0	1	1	2	0	1	2	2	1	1
118	NIKITHA	861528	2	2	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
119	DEEPAN	878070	1	1	1	1	1	0	0	1	1	1	0	1	0	1	1				0	1
120	MURUGAN	872138	1	1	2	2	2	0	0	2	2	1	0	1	1	2	0	1	2	2	1	1

KEY TO MASTER CHART

A)	AGE	1-1<YR; 2- 1 TO 5 YRS
B)	SEX	1- BOY; 2 –GIRL
C)	BTS CLASS	1- MILD TO MODERATE ; 2 –SEVERE
D)	TEMP	1- <38.5^C ; 2> 38.5^C
E)	HEART RATE	1- NORMAL; 2 – INCREASED
F)	SHOCK	0- ABSENT; 1- PRESENT
G)	MV	0- NO; 1 –YES
H)	TC	0-DECREASED; 1- NORMAL, 2- INCREASED
I)	NEUTROPHIL	1- NORMAL, 2- INCREASED
J)	PLATELET	0-DECREASED ,1- NORMAL; 2- INCREASED
K)	NEC	0- NG; 1- GROWTH
L)	CRP	0- NEG; 1- POSITIVE
M)	SODIUM	0-NORMAL, 1- MILD,2 – MODERATE, 3- SEVERE
N)	CXR	1- PNEUMONITIS; 2- BP; 3- CONSOLIDATION; 4- EMPYEMA
O)	OSMOLALITY	0- REDUCED; 1- NORMAL
P)	RPT SODIUM	0- REDUCED; 1- NORMAL
Q)	URINE SPOT	0- REDUCED; 1- NORMAL; 2 – INCREASED
R)	UR. OSMOL	0- REDUCED; 1- NORMAL; 2- INCREASED
S)	LOS	0- UPTO 7 DAYS; 1- 8 TO 14 DAYS; 2- >14 DAYS
T)	OUTCOME	0- DEATH; 1- IMPROVED